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1937

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MARCUS L. WARD, D.D.S., D.D.Sc., Ann Arbor, Mich.
President Elect of the American Dental Association

UNIV. OF MICH.

THE JOURNAL *of the*
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HABITS AND THEIR CONTROL DURING CHILDHOOD

By LELAND R. JOHNSON, D.D.S., M.S.D., F.A.C.D., Chicago, Ill.

WITHIN the last ten or fifteen years, much valuable psychologic material on the basic problems of child development has been added to the knowledge in this field. Unfortunately, in some instances, the wrong conclusions have been reached and applied, but these instances have led to more careful study, resulting in intelligent application of more logical interpretations. The investigation of adult maladjustments has called attention to the influence of early habits and has aroused interest in child development. The manner in which habits are formed is much more apparent in the child, particularly of preschool age, than in the adult, because the child has fewer fixed reactions.

A paper of this title when read before a section devoted to dentistry for children immediately brings to the mind of the dentist those habits of childhood which cause malocclusion, with its accompanying deformities. We must not lose sight of the fact that habit is perhaps our greatest ally in performing everyday tasks. In training the child, emphasis must be placed on habits that will increase the ability to cope with the varying situations of life, which become more complicated with increased age and responsibilities. This paper will be confined to those habits which are undesirable and harmful from the standpoint of the development of a normal occlusion.

James says:

> An acquired habit, from the physiological point of view, is nothing but a new pathway of discharge formed in the brain, by which certain incoming currents ever after tend to escape. . . . A simple habit, like every other nervous event—the habit of snuffling, for example, or of putting one's hands into one's pockets, or of biting one's nails—is, mechanically, nothing but a reflex discharge; and its anatomical substratum must be a path in the system. The most complex habits are, from the same point of view, nothing but concatenated

(Read before the Section on Children's Dentistry—Mouth Hygiene at the Seventy-Third Annual Session of the Chicago Dental Society, February 16, 1937.)

discharges in the nerve centers, due to the presence there of systems of reflex paths, so organized as to wake each other up successively—the impression produced by one muscular contraction serving as a stimulus to provoke the next, until a final impression inhibits the process and closes the chain.

When the child is learning to walk or the adult to play golf, he at first does many things that are already familiar to him. As trials are repeated, these acts are modified as he thinks is necessary to meet the situation. Certain movements are eliminated and others added, until a final pattern has been established. This is a "learned" response; and when it is frequently repeated, there is a tendency to make that response in each similar situation. At this point, the reactions are practically automatic. Thus is a habit formed.

Practically, habit minimizes the use of nervous and muscular energy, simplifies movements and makes them accurate and diminishes fatigue. Not only is the right thing done at the right time, but if the wrong thing is habitual, it is also done. If this were not true, we would never accomplish anything. If careful direction of consciousness were necessary each time an act is performed and if that act did not become easier after being repeated several times, the activity of a lifetime might be confined to only a few actions. The act of fastening a button, under these circumstances, would be as difficult on each occasion as on the first attempt and, because of the conscious effort, the child would soon become exhausted.

Fig. 1.—Several types of malocclusion caused by lip-biting.

Fig. 2.—Facial characteristics of typical lip-biter. (After McCoy.)

Habit is a common etiologic factor in malocclusion. It is most potent and far-reaching in its effect. It may be entirely responsible for a certain type of malocclusion or it may be only a contributing factor, complicating a situation having other etiologic factors. Orthodontists of experience recognize its significance and carefully investigate any possibility of an

existing habit. Many times, it is overlooked by those less experienced in diagnosis, and treatment is "finished," only to have the habit again cause malocclusion, and we say there was a relapse.

Habits, in relation to malocclusion, perhaps should be classified as (1) useful and (2) harmful. Useful habits should include the habits of normal function, such as correct tongue position, proper respiration and deglutition and normal use of the lips in speaking. The harmful habits include all that exert perverted stresses against the teeth and dental arches, as well as those habits, such as the open mouth habit, which inhibit the normal forces of the lips and tongue, so essential in the determination of the ultimate shape of the jaws.

Fig. 3.—Facial characteristics of patient with combined habits of lip-biting, tongue-thrusting and abnormal swallowing.

LIP-BITING

The most common and perhaps most frequently encountered habit is lip-biting. This type presents a myriad of variations and may be easy to detect in certain cases and difficult in others. Sometimes, these habits are performed so quickly that the eye is unable to detect them. In other instances, the lip may be held quietly between the teeth in numerous positions. The most common form of lip habit follows a definite sequence. The first motion of the act consists of wetting the lip or lips with the tongue. The lower lip is turned inward and the tongue goes back into the mouth. As the tip of the tongue passes the incisal edges of the maxillary incisors, the lower lip is caught between the maxillary and mandibular teeth and pressure is exerted as the lip slowly returns to its original position. The force produced by the lip as it slides over the teeth moves the maxillary incisors labially and the mandibular incisors lingually. The deformity reaches its maximum when the discrepancy between the maxillary and mandibular incisors becomes equal to the thickness of the lower lip.

The malocclusion is then retained by the lower lip. Variation of this habit, such as biting one side of the lower lip at a time, rotates the disto-incisal angle of the maxillary central incisors labially (Fig. 1). The characteristic facial expression of the lip-biter (Fig. 2) consists in protrusion of the maxillary incisors with the lower lip fitting under them when the mouth is closed. The upper lip may show fair development. Lip-biting may be accompanied by other habits such as tongue-thrusting and abnormal swallowing. Figure 3 shows the face of a girl whose lip-biting habit is complicated by tongue-thrusting and abnormal swallowing. These habits have been etiologic factors in a severe malocclusion (Fig. 4). The maxillary incisors are widely spaced and tipped labially. In the performance of this habit, the tongue is thrust forward as the lip is moistened. This is followed by an extreme upward and outward pressure of the lower lip against the lingual surfaces of the maxillary incisors in the first stage of the swallowing act. The continued repetition of this act has caused an extreme overdevelopment of the mentalis muscle.

TREATMENT OF LIP-BITING

Treatment of the lip-biting habit requires the utmost cooperation of the patient. The attention of patient and parent should be called to the habit and the harmful effects of continuing the habit should be carefully explained. To break the habit requires that the patient have the will to break it.

The motivation that will result in the "will to do" varies with each personality. It may be an appeal to the sense of pride, fear, punishment, reward or cooperative helpfulness. The fact that the habit is automatic and is done subconsciously means that some definite aid must be furnished the patient until the activating response has been eliminated. Correction of the malocclusion is of paramount importance so that the lips may be closed in comfort without an extreme effort. A pomade lipstick may be used as an aid to the patient. This will appeal especially to the very young girls, who want to use a lipstick as mother does. When the pomade is on the lips, the grease is felt when the tongue is thrust forward to wet the lips and attention is called to the act. In some instances, a mechanical aid may be used consisting of attachment bands on the maxillary incisors with spurs soldered on the lingual surfaces to prick the lip. This should be used only as a last resort and when the other methods have failed.

Tongue habits are particularly harmful and cause many of the worst cases of malocclusion. The tongue is probably responsible for most of the open-bite cases which are so difficult to treat. This habit may affect any part of the arch or all of the arch. In some instances, it is confined to the posterior segments either unilaterally or bilaterally. In others, it may exist only in the anterior portion of the arch. The habit usually consists of a thrusting of the tongue, which may, on the other hand, simply be held passively between the teeth. When associated with lip-biting, this habit may cause a malocclusion similar to that caused by lip-biting alone. Figure 5 shows a boy with extreme lip and tongue habits. There are several variations in the performance of his habits. The malocclusion is a severe open-bite case with only the molars in occlusion. The facial deformity which results from a severe open-bite malocclusion with a tongue habit as the etiologic factor is shown in Figure 5. Figure 6 shows the malocclusion.

Fig. 4.—Malocclusion shown in Figure 3. The habits in this case are lip-biting, tongue-thrusting and abnormal swallowing.

Theoretically, if the tongue habit is broken and ceases to exert pressure between the two arches, the incisors will continue to erupt until they meet in occlusion. The boy in this case was a cooperative child and treatment of the case was based on this fact. A lingual arch wire was constructed and placed to expand the maxillary arch. An exercise was given to teach normal tongue position and normal swallowing and, after eighteen months, the open-bite had closed approximately two-thirds (Fig. 7). At this stage, this method of treatment was

abandoned. McCoy open-tube appliances were placed on the maxillary and mandibular arches and intermaxillary force was applied to close the bite.

In most of these open-bite cases, the incorrect use of the tongue in pronunciation of certain sounds, such as "th," accompanies the habit and is a contributing factor in the malocclusion. Abnormal use of the tongue in deglutition is present in all open-bite cases as well as many other types of malocclusion, and the treatment of these tongue conditions is most difficult.

Perhaps the best method of teaching the proper use of the tongue in swallowing is one devised by Lloyd S. Lourie,

Fig. 5.—Facial deformity accompanying severe open-bite malocclusion with tongue habit an etiologic factor.

consisting of placing a small piece of candy on the palate behind the upper incisors and holding it there with the tip of the tongue. Each act of swallowing then is done with the tip of the tongue in correct position.

It is very important that the piece of candy be held just behind the incisors. If placed farther back on the palate, it will be held there by the dorsum of the tongue and the tip of the tongue will be free, as always, to fill the space between the teeth, and the purpose of the exercise will be defeated. The patient is urged to swallow, during meals, with the tongue in the corrected position. Occasionally, mechanical appliances with spurs may be used to discourage placing the tongue between the teeth. Correction of the misuse of the tongue in speech is also indicated.

One of the first forms of specific behavior which appears in the infant is sucking movements. This is a complex reaction and does not always occur when the lips alone are stimulated. Other muscle groups, such as cheek, tongue and those that control lip movements, are coordinated in sucking, and the stimulation of any one muscle group may result in sucking movements. Other types of stimuli that may cause sucking are odors, tastes and varying temperatures. After the first week, the sucking reaction becomes more specific, and it occurs primarily in response to lip or tongue stimulation.

LIP-SUCKING

One variety of the sucking habit is lip-sucking. Either lip may be sucked and the habit may have almost any variation. Figure 8 is the photograph of a girl who sucked the upper lip.

Figure 9 shows the type of malocclusion developed. It is evident that extreme pressure is being applied as the lip is sucked. The lip is alternately blanched and flushed as the blood is forced in and out of the lip as pressure is applied and relieved.

Figure 10 shows a boy who has a habit of sucking the lower lip combined with peculiar manipulation of the lips and tongue. Figure 11 shows his occlusion.

The principles applied in the treatment of thumb-sucking as well as those applied to correct lip-biting and tongue habits are of value in treating the lip-sucking cases.

During the teething periods, the condition of the gums leads to placing the

hand or fingers in the mouth, and that suggests sucking. This activity sets up a definite cycle, which includes the stimulation to repetition of the act itself. During the first year, many, if not all, infants occasionally get the thumb or finger in the mouth, but there should be a decrease in the act with age. One should not be alarmed unless the act is repeated too frequently. Figure 12 shows some of the different movements of an infant seven weeks old during the course of general activity. The fifth posture shows a possible source of stimulation to placing the thumb in the mouth.

THUMB-SUCKING

In some instances, sucking the thumb is accompanied by some practice that causes pain, such as pulling the hair or scratching the body. Habitual sucking of the thumb may cause a severe malocclusion and sometimes leads to a spinal curvature. Not all cases of thumb-sucking in early infancy cause malocclusion. If the habit is broken early enough and normal lip-function exists, the normal functioning lips act as an orthodontic appliance and correct the malocclusion. If this normal lip-function does not exist, the malocclusion in all probability will continue with increasing severity.

There have been many misleading articles and statements written in regard to the harmless effects of thumb-sucking. These conclusions have been based on studies which go only half way. It is indeed unfortunate that such information has been disseminated, since many cases of malocclusion and facial deformity are in the making as a direct result of the false sense of security that such articles have created.

Buford J. Johnson[1] says:

> Thumb-sucking as a problem in the child of one to five years of age probably has its basis in the failure of the diffuse activities of the infant to become differentiated into specific behavior toward an end. The relation to hunger is important. Since sucking movements are so frequent in early behavior and are associated with food-getting and with the preceding hunger reactions, the habit may easily be formed if periods of hunger are prolonged. A careful régime of feeding adapted to the child's activities does not alone prevent too frequent sucking of the fingers. The ends of activity for the infant appear to be other activities. When stimulation and opportunity for progessor movements and for manipulation are provided, the infant is less likely to suck the thumbs. Hard surfaces that offer resistance stimulate toward pushing, rolling, kicking and pulling. Objects that are stable and hold fast under the forceful attacks of the infant but which stimulate the child to climb, maintain equilibrium and experiment with movements provide for wholesome activities. The increased activity due to hunger may even be utilized in this way. When the infant is hampered by clothing, is placed upon soft beds and pillows during activity periods, or is provided dainty but wobbly pens, the gross muscle activities are curtailed. Compensation is often found in the easily accessible finger.

Fig 6.—Malocclusion in case shown in Figure 5.

Thumb-sucking is of two types: one which produces protrusion of the maxil-

lary incisors only and another producing protrusion of the maxillary incisors plus a distal relation of the mandible to the maxillae.

In the first type, the thumb is held so that pressure is exerted on the maxillary incisors in an upward and outward direction and the malocclusion produced is a neutroclusion. The maxillary incisors are tipped outward as in the lip-biter. Figure 13 shows a girl having this type of habit.

Figure 14 shows the malocclusion to be a neutroclusion.

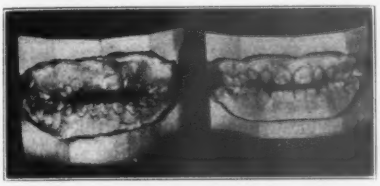

Fig. 7.—Left: Cast made before treatment. Right: Cast made eighteen months later, showing the improvement resulting from patient's efforts to learn normal use of tongue in swallowing.

if permitted to come into the house. The motivation in this particular instance was a desire to avoid an unpleasant situation. Perhaps this method should not be adopted as routine treatment in every case, and yet because of the individual response of this child to the situation created, the treatment was, in this instance, justified.

In the second type, the hand is allowed to drop in such position as to exert a prying force on the teeth. Not only are the maxillary incisors carried forward by the

Fig. 8.—Girl who sucked upper lip.

Fig. 9.—Malocclusion developed by sucking upper lip. (Case shown in Figure 8.)

It might be of interest to record here that this particular habit of thumb-sucking was broken by an appeal to fear at eight years of age. The mother, after trying all methods known to her to break the habit, found the child sucking her thumb one night shortly after going to bed. In exasperation, she took the child from her bed and put her on the porch. The child, fear stricken in the dark, readily agreed never to repeat the habit

thumb, but the alveolar process and the bone as well are molded into such form as to require special procedure in treatment of the malocclusion. The fulcrum of this "thumb-lever" is the point where the back of the thumb rests on the incisal edges of the mandibular incisors. A very heavy callus will be evident on the thumb at this point. Pressure is exerted in a backward direction and the mandible becomes locked in a distoclusion.

Figure 15 shows the malocclusion of a thumb-sucker who has sucked the thumb from birth to three years and six months of age.

Figure 16 shows this type of malocclusion when the habit is still unbroken at the eighth year.

TREATMENT OF THUMB-SUCKING

The treatment of the thumb-sucking habit is usually a tremendous task. No one method is successful in all cases. It is important that the habit be broken at an early age. Numerous mechanical appliances are used. In very young children, elbow cuffs, splints, aluminum mitts, wire frames for the thumb, etc., may be used, or the night clothes may be pinned. In older patients, the deciduous first molars may be banded and a bar constructed to extend across the palate. The bar may or may not carry sharp spurs and should stand far enough away from the palate to avoid any possible suction between the thumb and the palate. This may convert a pleasure-giving situation into an unpleasant one and thus effect a cure. Bitter aloe may be painted on the thumb, but its efficiency as a curative is doubtful.

Fig. 10.—Sucking of lower lip combined with peculiar manipulation of lips and tongue.

Another method which is successful in some cases involves practising the habit before a mirror. This method is based on the theory that when the habit becomes a conscious act, it is automatically broken. In its application, the child should be taken from his favorite play, placed in front of the mirror and told to suck the thumb as he watches the performance in the mirror. This should be done in the presence of the mother and the whole procedure should be undertaken in a serious mood. The length of each practice period should be governed by the age. A child will learn more in longer practice periods if relatively long intervals are allowed to elapse between periods than in repeated trials at short intervals.

Placing boxing gloves on the hands has been successful in numerous cases. The gloves permit freedom of movement and present a thumb too large for the mouth. This method is best applied to those cases in which the habit is practised as an aid in inducing sleep.

Fig. 11.—Occlusion of boy shown in Figure 10.

Again Johnson says:

> It is very doubtful if mechanical contrivances on fingers or splints to arms aid as much as they interfere in the elimination of the excessive thumb-sucking. They are likely to focus attention upon the arm or hand which is already associated with the

response, thereby serving as a stimulus. Restriction may accentuate the desire by continued stimulation of arm and finger and by interference with other activities that might supersede the sucking reaction. The infant often sucks clothing or bedcovering as a substitute. In the beginning, the emotional elements appear to be minimal but after the first year the thumb-sucking readily becomes a substitute activity under situations that arouse emotional excitation of a mild sort. With proper nutrition and desirable environmental conditions for gross muscle coordinations, it is doubtful whether excessive thumb-sucking would occur. When it has developed beyond the expected frequency, less attention to the reaction itself and more attention to provision of stimulation toward desirable activities would appear to be the better method of treatment.

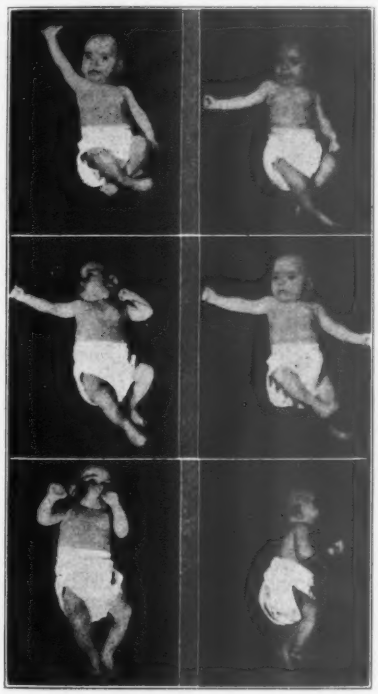

Fig. 12.—Movements of seven-weeks-old infant during course of general activity. The fifth posture shows a possible source of stimulation to placing the thumb in the mouth. (Buford J. Johnson in "Child Psychology"; courtesy of Charles C. Thomas.)

Events of the first year that have marked emotional elements affect the immediate behavior, and habits of response which may make for either maladjustment or efficiency will develop.

Mouth-breathing and the open-mouth habit are conditions quite frequently encountered. There is a difference between the two habits. One may have the open-mouth habit and still not breathe through the mouth. It is quite important to test the respiration to determine whether the patient is in reality a mouth-breather. The malocclusion may be any type. Figure 17 shows the type of face seen in the mouth-breather. Breathing exercises are necessary to teach the patient to keep the mouth closed. It is inadvisable to attempt to correct the habit, if the malocclusion is already established, until orthodontic treatment has progressed to the point where it is possible to close the mouth without too much effort. Figure 18 illustrates the open-mouth habit. This boy holds the mouth open at all times, but a test of the respiration reveals that he

Fig. 13.—Thumb-sucker who exerts upward and outward pressure on maxillary incisors only.

breathes through the nose. The malocclusion in this case is a neutroclusion presenting an end-to-end occlusion of the incisors (Fig. 19). It is obvious that the treatment in this case consists only in teaching the child to keep the mouth closed.

One of the worst features of the open-mouth and mouth-breathing habits is the loss of normal function of the tongue in the formation of the arches and palate. Correct function of the tongue in swallowing and its position at rest after swallowing are of primary importance in the treatment of these habits.

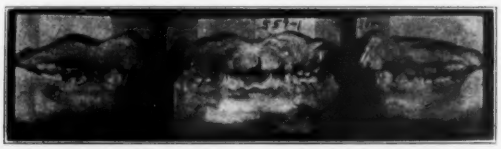

Fig. 14.—Case shown in Figure 13. This malocclusion is a neutroclusion and the incisors are tipped as in the lip-biter.

Fig. 15.—Malocclusion in child who has sucked thumb from birth to three years and six months of age. The condition produced is a distoclusion, illustrating type 2 thumb-sucking.

To teach the patient to keep the mouth closed calls for cooperation. When the child is reading or studying, a glass of water may be kept at hand. A sip of water is held in the mouth, and in case the mouth is opened, the water is spilled and this serves as a reminder to keep the mouth closed. If protrusion of the upper incisors is present, exercises to develop normal function of the orbicularis oris and mentalis muscles must be added.

Generally, the treatment of habits is an individual problem. The factor of individual differences is an extremely important consideration. Differences in children occur during the first years. One may appear shy and timid, while another is aggressive. A child may act one way in one situation and differently in another. By the age of two years, definite personalities have been developed. No two children live in the same environment even in the same family. Order of birth, sex, state of nutrition, physical condition and attitude of members of the family toward the child have an influence on behavior.

The problem of motivation is closely related to the personalities of the child and the dentist. By motivation is meant the aroused interest or intention of the child to perform an act, to reach a goal or to break a habit. To arouse this interest requires ingenuity, wisdom, personality, sympathy and understanding on the part of the dentist. In the child, the will to learn is influenced by the desire to receive attention from others, to be in pleasant situations and to avoid unpleasant situations. It is logical to assume that, in some cases, the pleasure derived from avoiding an unpleasant situation may be as desirable to the child as a reward.

Threats are frequently employed as motivating means, but general observa-

tion shows that this method is worthless. The only exception might be a threat rarely given and promptly executed. The harmful result of nagging and threatening is the formation of habits of avoidance. Experimental studies have shown that the consequences should be directly associated with the act. This is essential, in either punishment or reward, to gain new responses or to break down old responses. One might as well offer no reward as to promise one tomorrow or next week. It has no value.

The breaking of a habit is sometimes accomplished by building up an antagonistic response. This is the substitution of some other activity for the habitual activity. Children, as a general rule, are quite responsive to suggestion and will readily change from one activity to another. Occasionally, a child may habitually refuse to do the suggested act, and negative suggestibility may be applied. In this case, one would tell the child not to do the thing one desired him to do. This negativism is probably due to the fact that he has many times been thwarted and so it has been impossibile for him to carry through many self-initiated activities. Care should be taken to avoid undue excitement or irritability, since the breaking of a habit usually involves some emotional stress.

The problem of verbal instructions is always difficult. It requires skill to talk to children so that they understand, and wisdom to understand their replies. Not knowing the meaning of many words, the child relies a great deal on facial expression, gestures and actions of the adult. A child will learn to react to the frown of a parent as a sign of disapproval preceding punishment long before it understands the words associated with the act. Some people make a great mistake in assuming that they must alter their speech, actions and attitudes when conversing with a child. They should react toward the child as they do toward adults. True, certain variations of behavior are necessary, but that is also true of contacts with different adults. Another common fault to be avoided is too many associations or too much irrelevant talking in giving the child instructions.

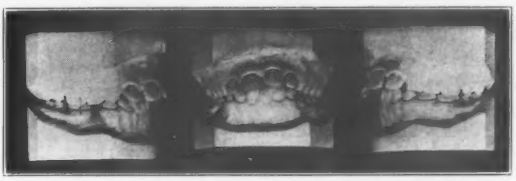

Fig. 16.—Malocclusion caused by thumb-sucking. The habit is still unbroken at eight years of age.

When it is desired that a child should remember certain acts a response should be made immediately. One often tells a child how to remember which shoe goes on one foot while putting it on for the child, then expects the child a day later to remember. If the child attempted to select the proper shoe immediately afterward he would be more successful under good instruction.[1]

It is indeed unfortunate that all mothers and fathers do not have the advantage of a good course in child psychology. The future generations would be much better equipped for their own and others' happiness. Many problems which worry the parents would be simple if understood and controlled. Dentistry has been slow

to include child guidance in its field. Most of the dental work is repair. Dentistry for children is a step in the right direction, and much preventive work is being done. Parents are advised to bring the children to the dentist at the age of two years. But what of habits and maladjustments which are already established? Dentistry will not assume its full responsibilities nor take advantage of its opportunities for prevention until the child is under observation from birth.

Fig. 17.—Characteristic facial expression of mouth-breather.

CONCLUSIONS

1. Many of our acts are secondarily automatic and are accomplished with comparatively little effort.

2. Habit may be an etiologic factor in malocclusion as well as an aid in the development of a normal occlusion.

Fig. 18.—Open-mouth habit. This boy is a nose-breather.

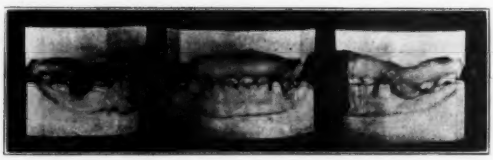

Fig. 19.—Occlusion in case shown in Figure 18.

Under these circumstances, the dentist should be prepared to control the factors in the development of normal occlusion and to advise and direct the parents to men in the different fields of medicine, dentistry, psychology, speech, etc., as the case requires. It is the pediatrician's duty to keep the child well, the dentist's responsibility to establish a normal occlusion.

3. Lip-biting is perhaps the most common habit causing malocclusion.

4. Tongue habits are responsible for some of the most severe cases of malocclusion.

5. One of the first forms of behavior of the infant is the sucking movement.

6. Sucking the thumb or fingers may cause a severe malocclusion.

7. If normal function of the lips exists,

after the thumb-sucking habit is broken in early childhood, malocclusion may be corrected by the functioning of the lips. If normal function does not exist, the malocclusion, in all probability, will continue with increasing severity.

8. Mouth-breathing and the open-mouth habit differ in their characteristics and treatment.

9. The treatment of habits in general is an individual problem.

10. To properly motivate the child to break a habit requires ingenuity, wisdom, personality, sympathy and understanding on the part of the dentist.

11. Threats as motivating means are generally worthless.

12. Reward or punishment should be directly associated with the act.

13. Undue excitement or irritability should be avoided, since breaking a habit usually involves some emotional stress.

14. Ability to so instruct the child that he understands is important.

15. To adequately carry on the work of prevention, the dentist should be prepared to control the definite factors in the development of a normal occlusion. To do this requires observation and guidance of the child from birth.

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180 North Michigan Avenue.

THE INFLUENCE OF EMOTIONAL STATES UPON TARTAR ACCRETION

By BERNARD B. BADANES, D.D.S., Ph.G., New York City, and CLARA B. PARODNECK, M.S.,* Brooklyn, N. Y.

THE concept of health is in need of enlargement to include the health of the oral cavity in its various phases. It must be recognized that the human organism reacts as a total unit, and that things mental cannot in reality be separated from things physical, since both respond to the same organismic function.

All mental phenomena, whether normal or psychotic, must be considered as the biologic reaction of the organism responding as a performing unit to the sum of its life condition. Psychic and somatic reactions are so interrelated that they must be studied together, and the total biological responses of the human organism may be spoken of as psychobiological.

It should be kept in mind that mental poise is an integral aspect and expression of health, just as health is expressed in varying types of behavior. When reasonable happiness in adjusting himself to life is denied the individual, he protests the situation by varying degrees of emotional and "personality" maladjustment. Psychoneuroses and intense emotions, originating from whatever cause, by affecting adversely the hormonal secretions of the

*Instructor in Physiology, Brooklyn College, Brooklyn, N. Y.

endocrine glands, are bound to give rise to many physical ailments and a variety of constitutional disorders.

THE DIGESTIVE TRACT

The natural processes of the alimentary canal are fundamental to all other functions of the body. The secretions of saliva, gastric juice and bile are stopped and the motion of the stomach and intestines cease at once, both in man and in the lower animals, whenever pain, rage or other strong excitement is present in the organism.

There is much evidence that a lack of minerals is one of the chief causes of dental caries. Actually, however, there may be no shortage of minerals in the food; but, if a psychosis is present, the food is not properly digested and normal absorption does not take place.

The secretion of the gastric juice is controlled by the vagus nerves. In Pavlov's opinion the sympathetic nerves also contain some secretory fibers, and he proved that, for the secretion and continuous flow of gastric juice, the psychic element is indispensable even if everything else is favorable. The principal action of the gastric juice consists in converting the proteins of the food into the diffusible peptones. The value of the gastric juice depends on the presence and activity of two substances, pepsin and hydrochloric acid. Pepsin stands apart from all other ferments by requiring an acid medium in order that it may act. Other acids may take the place of hydrochloric acid, but none acts so well. Lactic acid is often found in gastric juice, but this is derived by the fermentative process from food.

INTESTINAL TOXEMIA AND ACHLORHYDRIA

Neurasthenia is one of the many ailments whose rôle has been substantiated in its etiologic relation to calcium concretions in both renal and salivary calculi, originating from the disturbance in the phosphorus-calcium balance. The origin of the neurosis is in many cases traced to the digestive tract, and in quite a few instances to the oral cavity, where there are chronic degenerative changes taking place in the pulps due to slow irritation or other causes.

Sometimes disturbance in acid-base equilibrium may owe its origin to avitaminosis and bacterial activity, as has been shown by Osborne and Mendel,[1] in whose vitamin A-starved rats, stones of calcium phosphate often appeared in the bladders. They ascribe it to the fact that calcium phosphate will precipitate in an alkaline medium; by lowering the resistance to bacteria, these produce ammonia, which makes the urine alkaline instead of, as usual, faintly acid, and the stone formation then becomes the direct result of failure to resist the bacteria.

After studying many cases of mucous colitis, which is analogous to "ropy saliva" in dentistry, Bastedo[2] came to the conclusion that the headaches, the neurotic manifestations and the condition of mental and physical fatigability may in many instances be associated directly with a chronic toxemia caused by the absorption of food or bacterial poisons formed in the bowel or, possibly, of the dead bacteria themselves; and it is possible not only that the abnormal bowel condition of mucous colitis favors bacterial proteolysis, but also that the injured mucous membrane permits unusual absorption of deleterious materials. "If mucous colitis is sought for only where there is colic, the majority of cases will be missed; if it is sought for in every patient with persistent lassitude, persistent headache or a psychoneurosis, it will often be discovered." Bastedo also remarks that in such conditions there are usually other disadvantageous conditions, such as pyorrhea alveo-

laris and infections of nasal sinuses and the pelvis.

Most patients under prolonged grief and worry, leading to emotional instability, notwithstanding that they have all kinds of acids in their stomachs from chronic dyspepsia and fermentation, usually suffer from achlorhydria. Such a condition, Hurst[3] believes, allows intestinal infection to take place because of the lack of antiseptic effect of hydrochloric acid and, in turn, this intestinal infection leads to the absorption of toxic products in the intestinal tract. There are, according to Hurst, essentially two types of toxin produced, hemotoxin and neurotoxin, and the occurrence of the anemia or the neurologic symptoms as the outstanding feature of the disease depends on which one of the toxins is in the ascendency. "Other emotional states, as prolonged grief and worry, and that clinical symptom complex of emotional instability called neurasthenia, with its anemia, asthenia and constipation, have elements of a vicious cycle. The lower muscle tone and oxidation call for less food, which in turn produces more anemia and asthenia."[4]

CALCIURIA AND OXALURIA

Excess of calcium in relation to phosphorus, including calcium extracted from the bones in hyperparathyroidism, causes hypercalcemia, with the presence, perhaps, of calciuria and oxaluria, when the urine may become milky in color; this condition is commonly called "phosphaturia," and it may lead to both urinary and salivary calculosis.

Calciuria and oxaluria bear a direct relation to the condition wherein there occurs a hypersecretion of calcium salts in the saliva, and is clinically noticeable by the formation of much tartar about the teeth. A temporary slight derangement of the nervous system has been noticed by many observers to have an immediate effect on the reaction of the saliva. In testing the saliva of many individuals, Bunzell[5] found that any excitement affecting the nervous system had a marked effect upon the secretion of saliva.

Oxaluria is usually associated with nervous dyspepsia, mental depression and hypochondriasis.[6] DeSandro isolated an organism from a hysterical patient and from a patient with oxaluria which had the property of forming oxalic acid *in vitro* on the potato. Garrod[7] states that it is probable that, in the cases described by many investigators as examples of oxalic acid diathesis, attended with neurasthenic symptoms, the deposition of the oxalate crystals in the urine, saliva and other fluids of the body was largely due to such increased absorption as the result of the acid dyspepsia which was a permanent feature of this condition.

Neurotic patients often suffer from erosion of the teeth, which may be due to the fine crystals of the calcium oxalate[8] found in the gingival trough near certain teeth. Truman[8] also observed, among other things, that in all the patients with erosion of the teeth examined by him, the temperamental condition was markedly nervous.

NORMAL ALKALINE TIDE

Normally there is a diminution in acidity of the urine corresponding to the secretion of acid in the stomach after meals. Baehr[9] says that the relationship of this postprandial alkaline tide to the gastric secretion has recently been convincingly demonstrated by Hubbard and his collaborators. A similar precipitation of calcium salts from saliva takes place during the alkaline tide. This phenomenon was discovered long ago by Black.[10] During a study of the calculus deposit formed on his artificial denture, he observed that an intensification of calculus deposit oc-

curred usually from one hour to three hours after a heavy meal. This corresponded exactly to the postprandial tide.

THE PSYCHOPATHIC ALKALINE TIDE

While the normal postprandial tide lasts usually from one to three hours, the psychopathic alkaline tide may last for days, weeks or months. We meet frequently with apparently slight psychological disturbances which may, however, produce endocrine deviations and perverted hormone secretions with far-reaching consequences. The digestive tract is first attacked; then the whole organism is made to suffer indirectly when the acid-base equilibrium is unbalanced. This is most noticeable even in mild cases of elative-depressive types. Many of these patients have a variety of nervous symptoms ranging from simple introspective suggestibility to severe nervous breakdown. They are under a great emotional strain, and their adrenal secretion is comparable to that usually found during a state of fear or rage, when much energy is required. It is well established that the adrenals are very active under emotional conditions and their secretion helps to distribute blood to heart, lungs and central nervous system, but away from the abdominal viscera; as a consequence, such patients commonly suffer from dyspepsia and constipation. Emotional glycosuria, brought about by adrenal activity, has also been frequently found in animals and man.

It is not the excess in the total quantity of the lime salts that causes the alkaline tide and precipitation of the salts; but it is rather the shortage in the proper acids needed to combine with the basic elements to render them soluble that gives rise to calcareous deposition. Young[11] states that "during a period of neurasthenia diminution of phosphoric acid to about half and an increased calcium output have been found. The nitrogen was also decreased. It seems to be excessive calcium relative to phosphoric acid which leads to precipitation . . . (Emerson)."

Not only are all cells in the organism affected by a change in the relative concentration of calcium and phosphoric acid, but the physical properties of some of the colloids are so altered that activities of enzymes and ferments are changed or weakened, and the functions of the endocrine glands and hormones may become modified.

A very interesting case of excessive calculus formation was recently described by Finni and Gottlieb.[12] The patient, an elderly woman, developed auditory hallucinations and paranoid ideas. The outstanding feature which attracted the attention of the investigators was that the unusually heavy tartar accretion about the patient's teeth coincided with her psychopathic relapses. The chemical analysis of the deposits showed that they were a mixture of calcium oxalate, carbonate and phosphate, with a binder of mucin. Commenting on the case, the authors say that the solution of the identity of the inherent mechanism responsible for excessive calculus deposition awaits further experimental elucidation.

CHOLINE AND ACETYL-CHOLINE

Choline has a close relationship to systemic alkalinity found in neurologic patients. Choline is a peculiar base possessing both very useful and very harmful properties. It was first prepared by Strecker, in 1849, from bile. Choline is considered by a few investigators as a vitamin, while others hold it is a hormone, and still others ascribe to it the properties of both. It is taken with food and is also synthesized in the body. It is found normally in minute quantities in blood, spinal fluid, nerve and other tissues, mostly combined chemically in lecithin.

It acts as a stimulant on the non-striated muscles and helps locally in peristalsis. It is also an excitant to the salivary, lacrimal, gastric and other glands. It stimulates slightly the vasomotor centers. Its activity does not stop with death, for we find it as "cadaveric alkaloid" in decomposing flesh.

Choline is found in the poisonous mushroom *amanita.* It is also produced from sinapine, the alkaloid of white mustard. In large doses its action is similar to *curare,* paralyzing motor-nerve endings. Acetyl-choline, on the other hand, reported as being a thousand times stronger than choline, is held to be a true hormone and to control all our motions and activities, by its being discharged in extremely minute quantities at the motor-nerve endings.

Choline is found to be present in comparatively larger quantities than normal in psychopathic persons during relapses, and in many diseases related to the nervous system. Chemically, choline is trimethyl-ethelenehydrate-ammonium-hydroxide $(CH_3)_3{:}N(OH).CH_2.CH_2.OH$.

The reason why we are not poisoned by choline is that in the body it is ordinarily broken up by the action of bacteria into carbonic acid, methane and ammonia. The liberated ammonia, when in excess, combines with all available carbon dioxide, thereby setting free insoluble calcium bases, which we notice clinically, in their precipitation, forming heavy tartar accretions.

The general rise of systemic alkalinity resulting from the liberation of ammonia from choline when the latter is in excess, due to a neurotic spell or some other cause, may be the reason why choline is considered an auxetic in carcinoma. Patients suffering from cancer usually become neurotic from worry, and their blood shows a comparatively higher alkalinity than normal.[13]

Lack of choline in liver or pancreas is held as a factor in the etiology of diabetes. Depancreatized dogs lived but a few months with the aid of insulin, but when choline was added in the form of minced raw pancreas, they lived for years.[14]

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2 Cannon Street.

HISTOLOGIC AND CLINICAL STUDY OF HEREDITARY OPALESCENT DENTIN

By WILLIAM G. SKILLEN,* D.D.S., Chicago, Ill.

HEREDITARY opalescent dentin, a term adopted by Hodge[1] (1936) for a peculiar dental anomaly, seems to have come to notice only very recently. Apparently, it was first mentioned by Noyes[2] (1935) under the title of "Hereditary Anomaly in the Structure of Dentin." Within the last few months, three other cases have come to notice, and these form the basis for this report. Of the two terminologies mentioned, the former was chosen as it seemed to better describe the condition from the clinical angle, as well as definitely locating the defect.

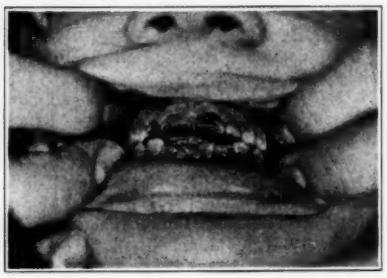

Fig. 1 (Case 3).—Loss of enamel from upper incisors and abnormality of lower incisors. (Compare Fig. 5.)

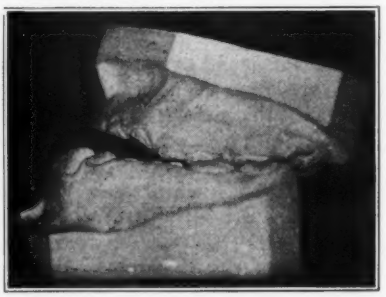

Fig. 2 (Case 2).—Excessive wear of teeth. (Compare Fig. 4.)

Clinically, many of the teeth in these cases had that peculiar coloration described by Noyes as bluish brown, with a peculiar refractive index, which presumably led Hodge to call them opalescent. This change in color and refraction is probably coincident with a progressive change in the dentin involving an almost complete disappearance of the pulp. In other words, not all the teeth in any one instance are equally involved, but may become so as obliteration of the pulp goes on.

In the cases under discussion here, the teeth on the whole appeared small, with constricted necks and relatively short, often blunt, roots. (Figs. 3-5.) The teeth were soft, fracturing and even crumbling readily under the pressure of the forceps. The enamel separated readily from the dentin, even *in situ*. (Fig. 1.) Many of the teeth, especially the first molars,

(From Northwestern University Dental School.)

(Read before the Section on Therapeutics, Pathology and Research at the Seventy-Third Annual Midwinter Clinic of the Chicago Dental Society, February 17, 1937.)

*Assisted by H. R. Rony, M.D., L. S. Fosdick, Ph.D., and Harold C. Hodge, Ph.D.

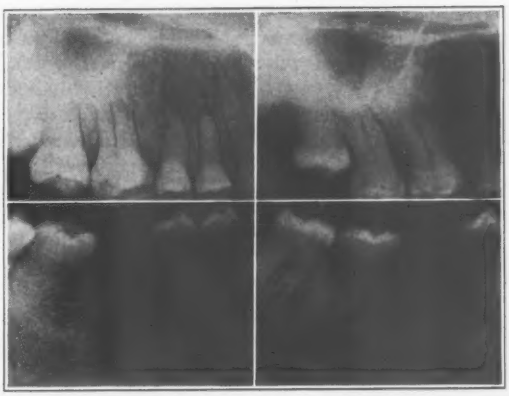

Fig. 3 (Case 1).—Varying density of teeth to passage of roentgen rays; absence of pulps even in developing third molars; appearance of bone, which seems more closely knit than usual.

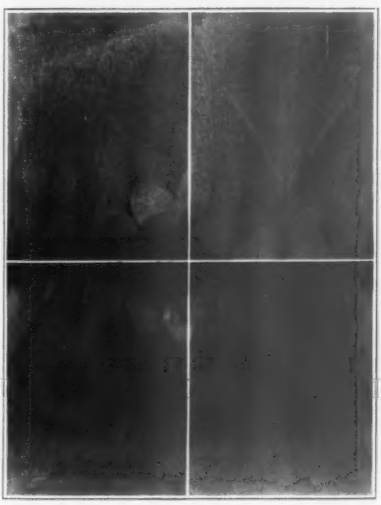

Fig. 4 (Case 2).—Shortened and blunted roots undergoing lacunar resorption; radiolucency of lower incisors as well as others; apparent compactness of bone in lower jaw.

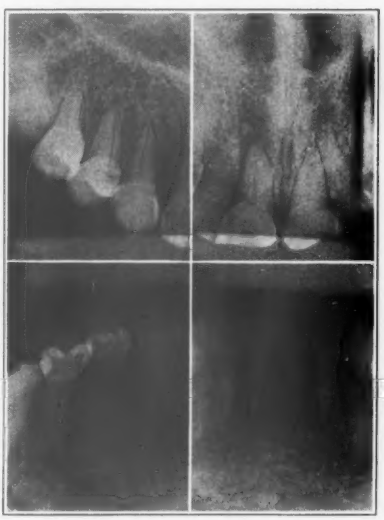

Fig. 5 (Case 3).—Absence of pulps in lower incisors and partial lack in bicuspids; radiolucency of different teeth, and wear.

showed excessive wear (Fig. 2), but apparently no pain had ever been experienced because of this.

Roentgenograms showed the pulps to be entirely, or almost entirely, obliterated even in teeth which were not yet fully developed. (Figs. 3-5.) The teeth exhibited a variable density to the passage

of the roentgen rays, this apparently being dependent on the character and degree of change which had occurred in the dentin.

Physical examination, as far as it was possible to make it, as Hodge has remarked, failed to indicate anything radically wrong or anything that might be related to the condition. The blood picture seemed normal in every way. Analysis of the teeth showed in general that the dentin was very much below the average in hardness and that the roentgen-ray absorption value was very low. Chemical analysis of the dentin indicated a condition of hypocalcification with a high water and low inorganic content. The calcium salts deposited were either normal or only slightly abnormal, as indicated by the calcium-phosphorus ratio.

From the microscopic standpoint, the enamel appeared to be normal in structure. The entire disturbance seemed to be in the dentin. As has been said, the pulp is gradually obliterated by the continuous formation of a very irregular dentin, until only small, irregular tuft-like portions are left. The dentin is so irregular that it practically defies description. The dentinal tubules do not maintain their normal direction or size. Some become quite bulbous and so large in many regions that it is difficult to determine whether they are tubules or pulpal inclusions. (Figs. 6-8.) Interglobular spaces are extremely numerous, indicating a very poorly calcified structure. (Fig. 9.) In the specimens examined, the mantle dentin in the crown area was the only portion of the dentin which appeared normal. (Fig. 10.) Nothing was observed in the appearance of the pulp that could be said with any degree of surety to be particularly abnormal. The cementum was normal, varying only in

Fig. 6 (Case 1).—Constriction of pulp; irregular dentin; normal cementum and resorption of apex.

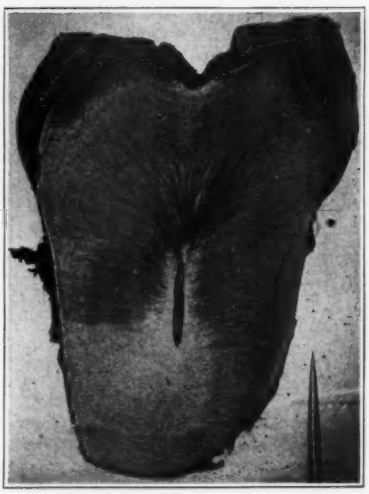

Fig. 7 (Case 2).—Similar condition to that shown in Figure 6.

thickness and irregularity about the different teeth. (Fig. 11.) The peridental membrane was perfectly normal. Examination of some of the blunt, short-rooted teeth revealed that these were undergoing lacunar resorption. The position of the epithelial attachment about the lower incisors in the two cases thus examined placed these teeth in the second stage of eruption.[3] (Fig. 12.)

tion of the small amount of material available. (Figs. 12-13.)

Although it was not possible to obtain complete histories, or even quite the same history on the three persons represented in this report, the foregoing description, in a general way, fits fairly accurately all three cases, and agrees in part with the findings of the above-mentioned observers. But, as Hodge has remarked, ap-

Fig. 8 (Case 1).—Common appearance of dentin. The heavy, dark masses are probably pulp tissue, while the finer branches represent the tubules. Interglobular spaces are also present. (Ground, stained specimen.)

From the roentgenogram, the impression was obtained that perhaps the bone about the teeth and in the jaws was somewhat more dense than usual. This seemed to be borne out by microscopic examina-

parently there is no abnormality common to all persons, save that of defective dentin. These variations will be made clear by the following detailed history of each case.

REPORT OF CASES

CASE 1 (Figs. 3, 6, 8 and 14).—A girl, aged sixteen, who had no recollection of the appearance of this condition in any other member of the family, and of whom no physical examination was made, on chemical analysis of the dentin of the teeth, showed a high calcium-phosphorus ratio, namely 2.365, with a calcium value of 26.5 and a phosphorus value of 11.4. This indicated a hypocalcification of the dentin with the deficiency in phosphorus much greater than that of calcium. The phosphatase was below normal; 2.0 mg. of phosphorus being liberated when 50 mg. of dentin was acted on by sodium glycerophosphate for twenty-four hours. The normal, according to this procedure, is 4.2 mg. All results indicated a poorly calcified structure; a conclusion which was borne out by histologic examination.

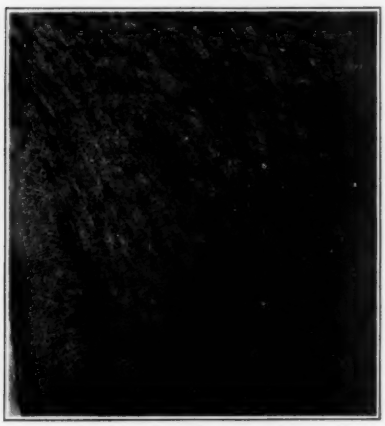

Fig. 9.—Decalcified, stained specimen showing irregularity of calcification as indicated by dark and light areas. The former are the calcified areas.

CASE 2 (Figs. 2, 4 and 7).—A girl, aged seventeen, was given a complete physical examination, which proved negative, as the following results indicate: basal metabolic rate, +4.4 per cent; blood calcium, 10.6; blood phosphorus, 4.23; cholesterol, 105 mg. per cent; blood phosphatase, 4.65 Bodanski units. Of previous diseases, the patient mentioned only anemia at the menarche at the age of thirteen. Menstruation had been regular, but the intermenstrual period was fourteen to sixteen days until about two years ago, when it became twenty-one to twenty-four days.

A roentgenogram of the hand (Fig. 15) revealed that the progress of ossification was somewhat advanced, corresponding to that of a normal twenty-year-old girl. Skull suture and vascular markings were normal and the calvarium was normal in thickness. There were no unusual deposits of calcium in the calvarium nor in the region of the pineal gland. The sella turcica was oval, bridged over on the right side and within the lower limits of size for a normal adult.

Fig. 10.—Normality of mantle dentin (A) and irregularity of succeeding layers in crown region.

The history brought out the fact that this condition had been present in the great-grandmother, the grandmother, the grandmother's brother and the father and was now present in the girl's brother. Accompanying the dental defect and also present in all of these persons was a peculiar knee abnormality, consisting of a looseness of the kneecap.

Analysis of the dentin of two of the patient's teeth, as prepared by Harold C. Hodge, showed a hypocalcification, indicated by a high water and low inorganic content.

Fig. 11.—Irregularity in cementum, of frequent occurrence in these cases.

The inorganic constituents were either normal or slightly abnormal, as indicated by the calcium-phosphorus ratio, as follows: calcium, 33.5 and 34.6; phosphorus, 16.1 and 16.4; giving ratios of 2.08 and 2.11, respectively. The microhardness and roentgen-ray absorption values were very low.

Case 3 (Figs. 1 and 5).—A boy, aged twelve, the brother of the patient in Case 2, presented, in spite of his youth, first molars that were almost worn to the gum line. The pulps of the lower incisors were completely obliterated and almost so in the bicuspids. Considerable enamel had chipped off the upper incisors. In every respect, the teeth resembled those described as characteristic of hereditary opalescent dentin. He had the same linked hereditary characteristic as his sister. No other studies of this patient have been made up to the present time.

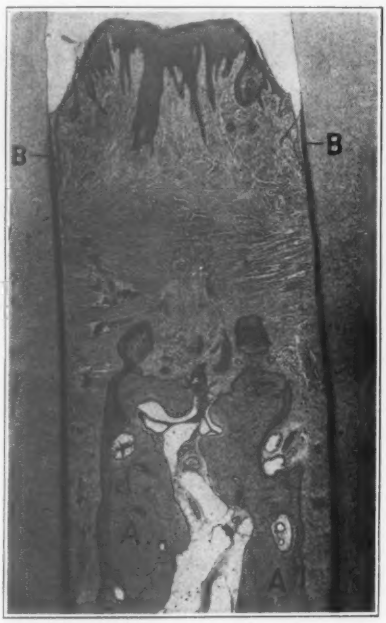

Fig. 12 (Cases 1 and 2).—Presumed excessive thickening of lamina dura (A); epithelial attachment (B) in interproximal position of lower incisors.

RÉSUMÉ

At the present time, hereditary opalescent dentin seems to have the following common characteristics: a bluish brown

Fig. 13 (Cases 1 and 2).—Obvious increase in density of alveolar process in interproximal area of lower incisors.

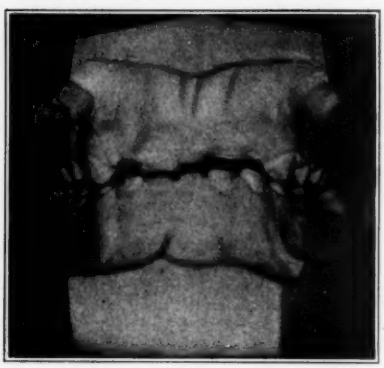

Fig. 14 (Case 1).—Model of teeth, showing wear in incisor region.

hue and opalescence; softness of the teeth, subjecting them to rapid and excessive wear, and obliteration of the pulp by the continuous formation of a hypocalcified and extremely irregular dentin with a

Fig. 15 (Case 2).—Roentgenogram of hand of patient, showing advanced ossification.

low microhardness and roentgen-ray absorption value.

The defect seems to exist in the dentin alone. Nothing accurately determinable as abnormal could be observed in regard to the pulp.

All other structures related to the teeth, with the possible exception of the occurrence at times of a very irregular cementum, appear to be normal. The bone appeared to be more compact than usual.

Physical examination fails to indicate anything radically wrong.

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EXPERIMENTAL ALVEOLECTOMY

By ROLAND S. CLAFLIN, D.D.S., M.D.S., Chicago, Ill.

ALVEOLECTOMY has now become part of the routine of dental practice. The operation is performed for the purpose of reconstructing the shape and contour of the residual alveolar ridges. This report will be confined to the discussion of experimental work undertaken to demonstrate the actual tissue changes associated with this operation.

In reviewing the literature on experimental alveolectomy, only two authors have been found who have done work similar in procedure to that carried out in my experiments; namely, Schram in the United States and Balogh in Hungary.

Schram[1] experimented on the maxillary bones of dogs for the purpose of obtaining definite knowledge in regard to osseous regeneration after surgical interference. He removed teeth by making an incision into the gingiva and deflecting the gingiva and periosteal tissue covering the labial surface of the alveolar process. He then chiseled away the bone overlying the buccal roots, so that the tooth could be tipped out of the socket toward the buccal side, and replaced and sutured the flaps. A corresponding tooth on the other side of the jaw was extracted as a control. The time allowed for the healing of the extraction wounds in the experiment was eight, fourteen, twenty-one and forty-eight days.

Schram offered the following conclusions from this comparative histologic study of alveolar wounds and simple extraction wounds: In simple extraction wounds, the epithelium over the socket is closed eight days after the extraction, and new bone has already begun to form at the fundus of the socket. In forty-eight days, the healing of bone appears complete.

Schram found that the wounds following surgical extraction heal somewhat more rapidly than forceps extraction wounds because of the limited area of the blood clot. He also states that new bone

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(Read before the Section on Oral Surgery, Radiology and Anesthesia of the Seventy-Third Annual Midwinter Clinic of the Chicago Dental Society, February 16, 1937.)

appears on the margin of the old bone after approximately eight days. Bone apparently does not arise from the mucoperiosteal flap, but from the surrounding bone. The form of the new edentulous ridge is typically different from that present after forceps extraction. In my own previous work,[2] on the healing of undisturbed extraction wounds, new bone was first found in the same areas as those mentioned by Schram,[1] but five days after instead of eight.

Balogh[3] studied the work of Euler and Szabo on undisturbed extraction wounds and decided that it would be interesting to investigate the healing of extraction wounds under atypical conditions. His experiment was carried out on dogs. The teeth were extracted after the facial bone plates were cut away. The healing time of the wounds in Balogh's experiment was four, eight and fourteen days and four, six, eight, twelve and sixteen weeks.

In summarizing the results of the histologic findings, Balogh comes to the following conclusions: The healing processes of extraction wounds after the surgical removal of the facial bone plate are the same as in the healing of undisturbed extraction wounds, the only difference being that extraction wounds closed after the removal of teeth heal more rapidly. This may be partly due to the suturing of the margins of the wounds, or to the fact that the wound cavity has been made shallower by the removal of the facial bone plate. Balogh states that complete healing has taken place after twelve weeks.

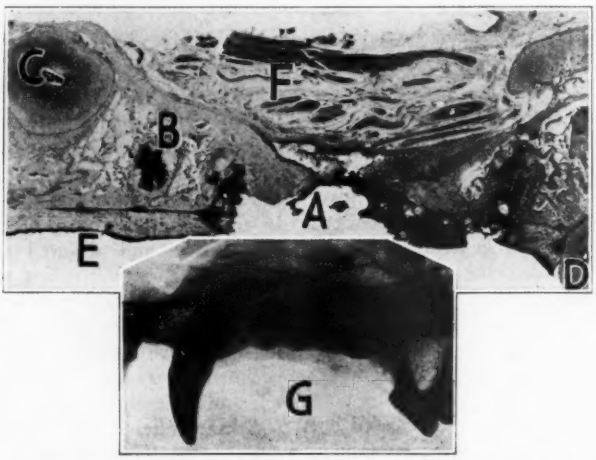

Fig. 1.—Extraction wounds five days old; alveolectomy performed immediately after extraction of teeth. A, area of infection; B, socket of first premolar with blood clot; C, canine; D, carnassial; E, epithelium; F, nasal tissue; G, roentgenogram of jaw from canine to carnassial.

At this point, a few words must be said about the terms "healed extraction wounds" and "healing of extraction wounds." Clinically, we call a socket healed when it is completely filled with new bone. We know that such a socket continues to undergo bone changes and that these changes will probably go on for many months or possibly years before the wound can be considered healed histologically. Strictly speaking, the healing

of an extraction wound is not completed until the new bone that has filled the socket has changed into the same architectural form as that of the surrounding bone and until the trabeculae have arranged themselves more or less at right angles to the outside cortical plate in order to perform their new functions.

The term "healed extraction wound" as used in this paper means an extraction wound that is completely filled with new bone, as it would be very difficult to know when healing was histologically complete.

The dental formula of the dog's dentition is given here so that conditions described in this paper will be more easily understood:

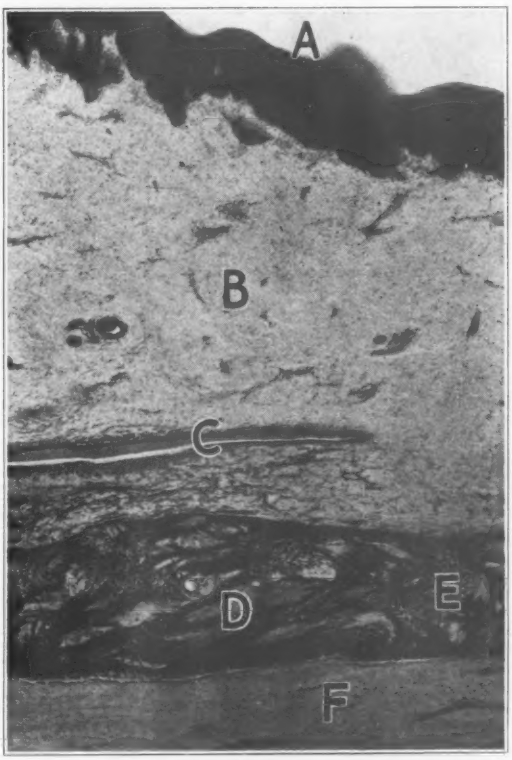

Fig. 2.—Higher magnification of area E in Figure 1, showing bone filings between mucous membrane and bone. A, epithelium; B, subepithelial connective tissue; C, blood vessel; D, bone filings; E, connective tissue between the bone filings; F, bone.

$$\frac{1_1 1_2 1_3 \text{ Canine } P_1\ P_2 P_3 \text{ Carnassial } (P_4)\ M_1 M_2}{1_1 1_2 1_3 \text{ Canine } P_1 P_2 P_3 P_4 \text{ Carnassial } (M_1)\ M_2 M_3}$$

The procedure of alveolectomy in this experiment on dogs is the same as is followed in man previous to the insertion of artificial dentures. In one dog, the teeth

were extracted from the canine region back to the carnassial region on both sides in both jaws. After the extraction, the mucous membrane and periosteum covervals. This gave extraction wounds that had been surgically prepared with healing time of five, ten, fifteen and twenty days.

In another dog, the teeth from the cus-

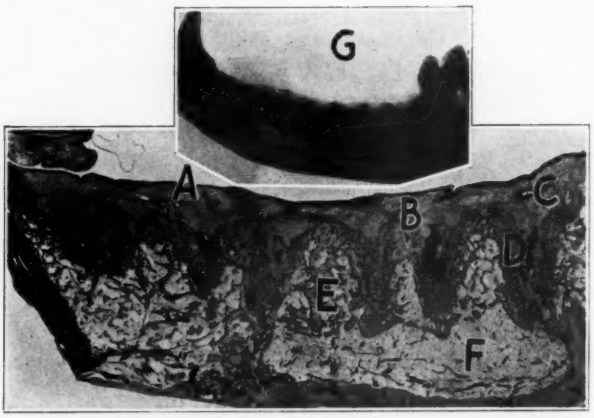

Fig. 3.—Extraction wounds ten days old; alveolectomy performed immediately after extraction of teeth. A, epithelium; B, subepithelial tissue; C, suture hole; D, socket of fourth premolar; E, supporting bone; F, marrow space; G, roentgenogram of jaw from canine to carnassial.

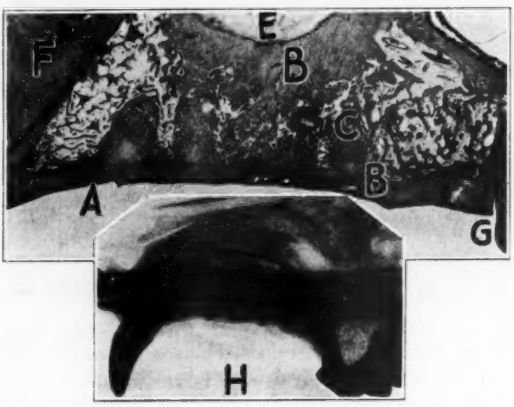

Fig. 4.—Extraction wounds fifteen days old; alveolectomy performed immediately after extraction of teeth. A, epithelium; B, suture holes; C, socket; E, nasal mucosa; F, canine; G, carnassial; H, roentgenogram of jaw from canine to carnassial.

ing the jaw bone on the upper right side, upper left side and lower left side were similarly operated on at five-day interpid to the carnassial regions were extracted, and, seven days later, one side was surgically prepared, the other side being

left undisturbed. Twelve days after the alveolectomy, the dog was killed. Thus, at the time the animal was killed, the jaws had been healing for nineteen days.

In still another dog, the premolars were extracted on both sides of the mandible and on one side an alveolectomy was performed immediately after the extraction. These jaws were allowed to heal for ten days.

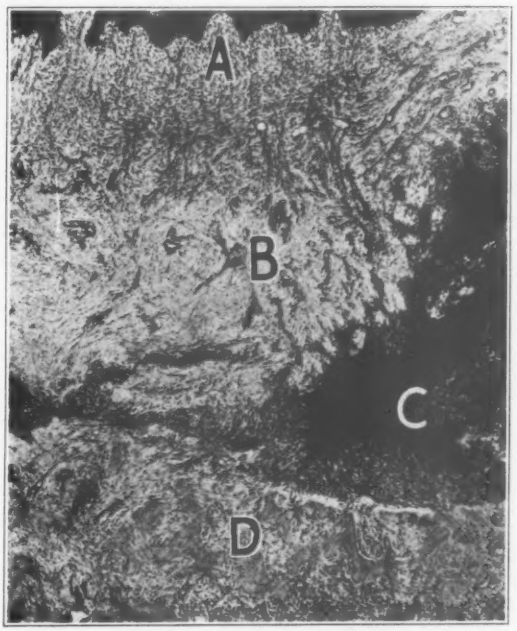

Fig. 5.—Higher magnification of area A in Figure 4, showing new bone developing from crest of the jaw that was trimmed surgically. This new bone is regenerating toward the mucoperiosteal flap. A, epithelium; B, subepithelial tissue; C, clot in a state of organization; D, new bone.

In the first dog, the healing time of the wounds was five, ten, fifteen and twenty days; in the second dog, seventeen days, with ten days from the time of operation, and in the third dog, ten days. In this experiment, the procedure of the surgical preparation was somewhat different from either Schram's[1] or Balogh's[2] technic. These two authors removed only the outside buccal or facial plate of bone; whereas, in my experiment, both lingual and facial bone plates were trimmed.

This experiment was carried out for the following purposes:

1. To compare surgically closed extraction wounds with undisturbed extraction wounds.
2. To determine the effects of sutures on the healing of extraction wounds.
3. To study the healing of the periosteal flap after the removal of the cortical plate of bone.
4. To study the effect of bone filings on wounds.

5. To determine whether there was a difference in the location of the new bone formation in closed wounds as compared to open wounds.

6. To determine the areas of resorption in surgically prepared wounds as compared to undisturbed extraction wounds.

Figure 1 is a photomicrograph of the upper right side of the jaw from canine to fourth premolar tooth. This jaw was surgically prepared after the extraction of the teeth and then sutured. For some unknown reason, infection developed around the sockets of the second and third premolars. The soft tissue became

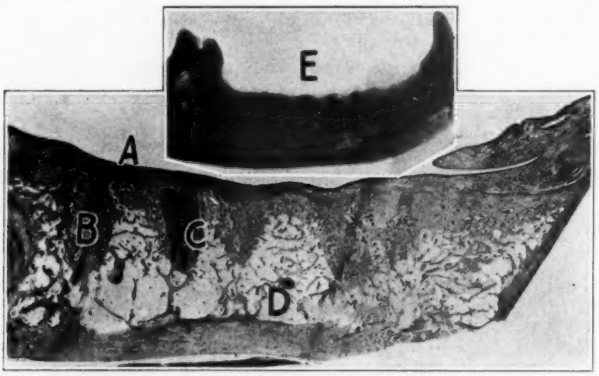

Fig. 6.—Extraction wounds twenty days old; alveolectomy performed immediately after extraction of teeth. A, epithelium; B, distal socket of fourth premolar; C, mesial root of fourth premolar; D, body of mandible; E, roentgenogram of jaw from canine to carnassial.

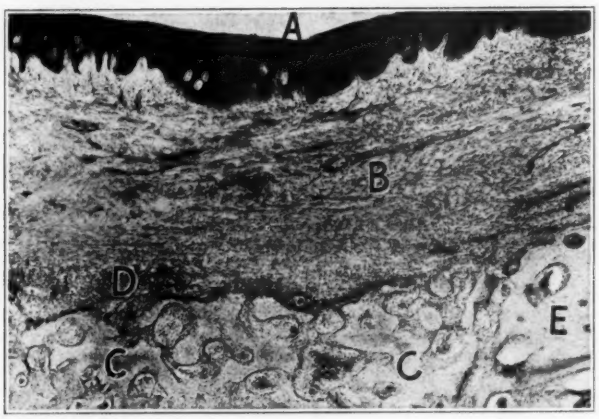

Fig. 7.—Higher magnification of distal socket of fourth premolar in Figure 6. A, epithelium; B, subepithelial connective tissue; C, new bone in socket; D, osteoclasts on new bone formed in socket; E, original cribriform plate of socket.

detached from the bone. The sutures broke, and pieces of necrotic bone are being exfoliated. In the roentgenogram, this infection cannot be detected, since the elapsed time (five days) was not long enough to produce bone changes that would be visible roentgenographically. In the socket of the first premolar and in the distal socket of the third premolar, a normal blood clot is present. New bone has just begun to form at the fundus of these sockets.

the operation, and when it was returned to its original position, the bone filings were retained under it. These filings are surrounded by young connective tissue and seem to be well tolerated. A few osteoclasts are visible on these pieces of bone. Some of the filings show empty lacunae, but in others the osteocytes are still present. Figure 3 is a general view of the lower jaw on which an immediate alveolectomy was performed from the canine to the carnassial regions. This

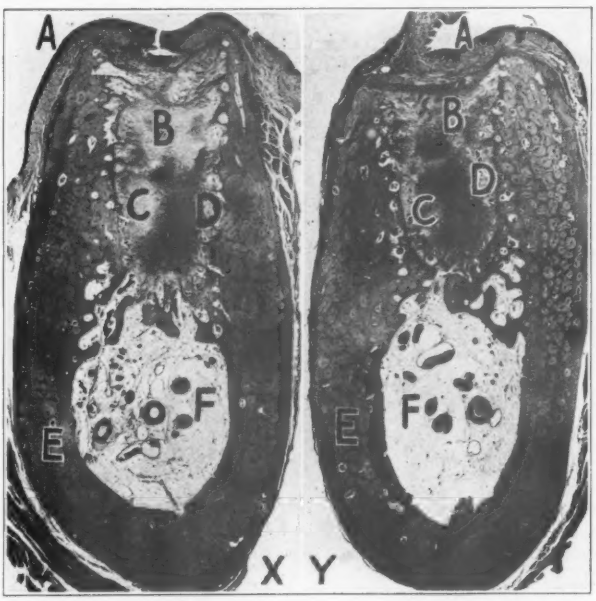

Fig. 8.—Buccolingual sections of ten-day-old wounds. The photomicrograph on the left shows the control extraction wound and the one on the right the corresponding socket in which extraction was followed by an immediate alveolectomy. X, control side; Y, surgically prepared jaw. A, epithelium; B, socket; C, scar tissue; D, new bone; E, body of mandible; F, mandibular vessels and nerves.

A higher magnification of the tissue overlying the socket of the third premolar in Figure 1 is shown in Figure 2. It shows a bone filing between the periosteum and the jaw bone. The periosteum had been laid back in this area during

wound is ten days old. New bone has filled in toward the central portions of the sockets. The central portion of the wound is still filled with the remnants of the blood clot and with young connective tissue. The areas over the first and

fourth premolar show a lapping of the tissues. The amount of newly formed bone tissue is approximately the same as in undisturbed extraction wounds of the same age.

Figure 4 is a general view of the upper jaw after immediate alveolectomy. This wound is fifteen days old. The epithelium has several openings caused by sutures. The sockets are well filled with new bone, except for the central portion, which still consists of scar tissue. It appears that more bone is present at this length of time that the sutures were allowed to remain in place.

In the surgical preparation of the jaws, the buccal cortical plate of bone was removed and the mucoperiosteal flap was placed over this roughened bone area. In this area, the regeneration of new bone seems to take place in the direction of the periosteum.

Figure 6 is a general view of the lower jaw on which alveolectomy had been performed immediately after extraction of the teeth. This wound is twenty days

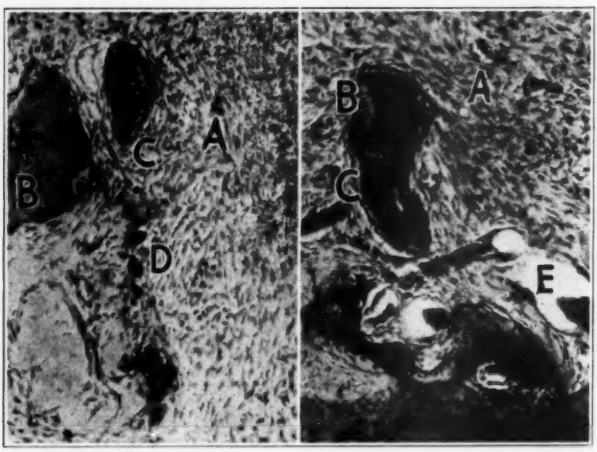

Fig. 9.—Higher magnification of C in Figure 8, Y, showing bone filings in socket. A, young connective tissue; B, bone filings; C, new bone formation around the filings (osteoblasts); D, osteoclasts around the bone filings; E, blood vessels in young scar tissue.

time than in an undisturbed extraction wound of equal age.

A higher magnification of Figure 4 showing new bone tissue forming from the surgically prepared bone toward the periosteum is shown in Figure 5. From a study of the epithelium over these wounds, the healing of the suture holes seems retarded in comparison with the other reparative tissue changes in these wounds. This may have been due to the old. There is no evidence of unhealed suture holes. The epithelium is smooth over the entire area. Over the second premolar is a small epithelial cyst. The sockets are filled with bone tissue to the crest of the ridge. In the sockets of the fourth premolar, a small central area of scar tissue remains. In the distal socket of the third premolar, there is a fractured root tip, which is healing in without any disturbances to the overlying tissue. In

this stage of the healing process, the regeneration of bone in the surgically prepared jaw is much farther advanced than in an undisturbed extraction wound of the same age.

Figure 6 A shows the epithelial cyst that was described over the mesial root of the third premolar in this cross-section. The papillae of the epithelium are absent. This cyst probably originated from a group of epithelial cells which were implanted in the deeper tissues during the operation and continued to grow there.

Figure 7 is a higher magnification of the alveolus of the second premolar in

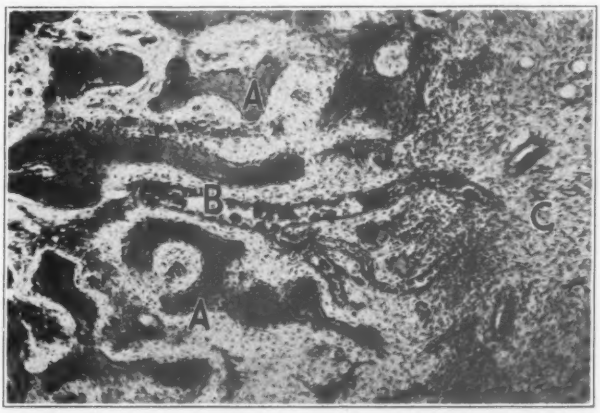

Fig. 10.—Higher magnification of new bone in Figure 8, Y, showing development of blood vessels in new bone. A, new bone surrounded by osteoblasts; B, longitudinal section through vessels; C, scar tissue in central portion of socket.

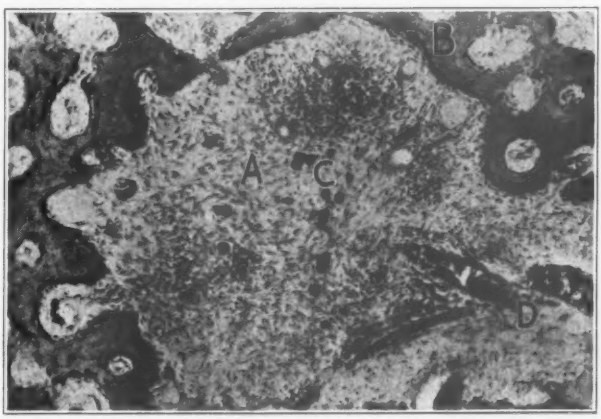

Fig. 11.—Higher magnification of epithelial rests of periodontal membrane found in central portion of socket in Figure 8, Y. A, scar tissue; B, new bone; C, epithelial rests; D, vessels.

Figure 6, showing the socket well filled with new bone tissue up to the crest of the interradicular septum. On the surface of this new bone tissue are many osteoclasts. The surface epithelium and subepithelial tissue are little different from the normal mucous membrane of the dog.

The accompanying illustrations show buccolingual sections through the right and left side of the mandible of the same animal. On the one side (left), the teeth were extracted and the wound was left undisturbed. On the other side, the bone was trimmed surgically after the extraction, and then the mucoperiosteal flap was sutured. In Figure 8, on the right, is a buccolingual section through a surgically prepared jaw. On the left is the control, the same tooth of the other side of the jaw. The only difference at this time between these two extraction wounds is that the epithelium is completely closed over the wound that had been sutured. The suturing of the mucoperiosteal flaps eliminates the five to eight days necessary for the epithelium to proliferate over the opening of the sockets. This closure of the wounds also reduces the possibility of injury to the blood clot. The amount of new bone tissue formed in the new wounds is approximately the same. During the operation, bone filings had fallen into the socket. These are visible in Figure 9 under high magnification, completely surrounded by new young connective tissue. Apparently, they act as individual centers of ossification. The new osteoid material formed around them is completely covered with osteo-

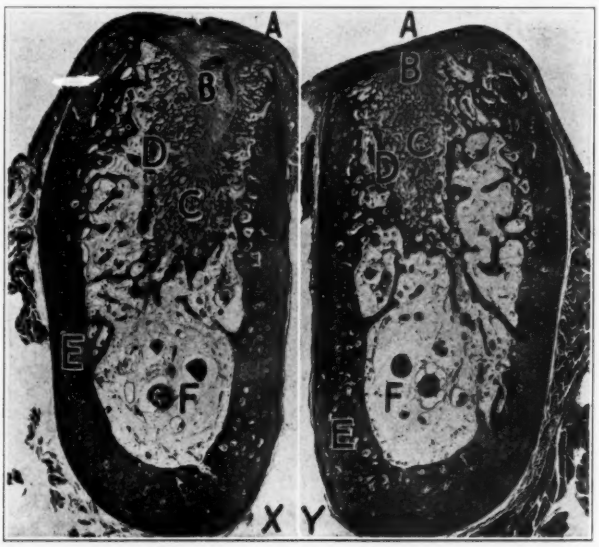

Fig. 12.—Extraction wounds of lower third premolars, seventeen days old. The photomicrograph on the left (X) is the control jaw and the one on the right (Y) the surgically prepared jaw. A, epithelium; B, remnants of scar tissue in sockets; C, new bone in sockets; D, cribriform plates; E, body of mandible; F, mandibular vessels and nerves.

blasts. In other areas, osteoclasts can be seen resorbing some of the old bone material.

The vascular development can readily be seen in Figure 10. The longitudinal section of a vessel is present between the spicules of new bone leading into the young connective tissue at the central portion of the socket. The young bone in this section is completely surrounded by osteoblasts.

Figure 12 is an extraction wound seventeen days old. On the left side is a control or undisturbed extraction wound; on the right, a surgically prepared wound (third premolar). At this time, a marked difference can be seen between the two wounds. Over the side where simple extraction had been performed, the epithelium has become

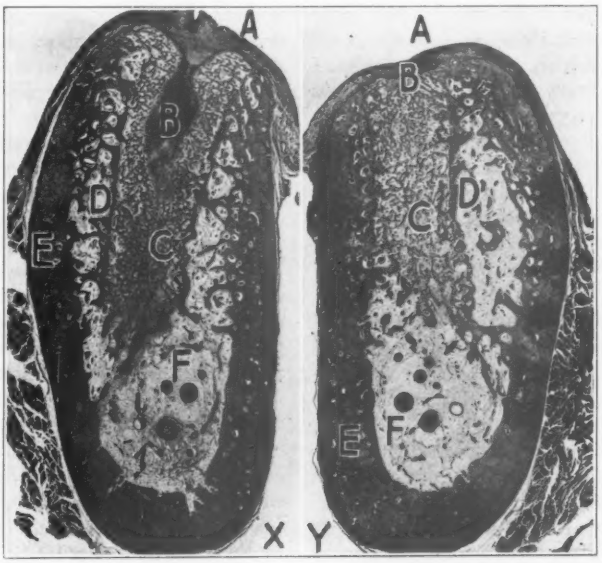

Fig. 13.—Extraction wounds of lower fourth premolars, seventeen days old. The photomicrograph on the left (X) is the control jaw and the one on the right (Y) the surgically prepared jaw. A, epithelium; B, remnants of scar issue in central portion of socket; C, new bone in sockets; D, cribriform plates; E, body of mandible; F, mandibular vessels and nerves.

Epithelial rests, or rests of Malassez, are found in the central portion of the clot shown in Figure 11. These epithelial cells are found in the periodontal membrane. Portions or shreds of the periodontal membrane were probably torn loose during the extraction, and formation of the blood clot around them left them in the central part of the socket.

united, but has not yet taken on the characteristics of the normal oral epithelium. The central portion of the alveolus is still filled with scar tissue. Only the fundus and the side walls of this wound are covered with new bone tissue. On the surgically prepared side, the osseous regeneration has taken place almost to

the crest of the jaw. The epithelium over this socket is not newly formed, but is the mucoperiosteal flap that was sutured over the socket.

An extraction wound of the fourth premolar seventeen days old is shown in Figure 13. On the left is an undisturbed extraction wound; on the right, a surgically prepared wound. The central portion of the undisturbed extraction wound is still uneven, and no papillae are present. The surgically prepared jaw shows the socket completely filled with new bone with the exception of a small central depression. By comparing Figure 10 with Figure 11, it becomes obvious that bone regeneration has taken place more rapidly from the tenth to the twentieth day in the surgically prepared and closed wounds than in the corresponding undisturbed extraction wounds (controls).

SUMMARY AND CONCLUSIONS

1. A comparative study was made of experimental wounds resulting from simple extraction and wounds resulting from extraction and subsequent alveolectomy.

2. After the extraction of teeth, the mucoperiosteal tissue overlying the crest was deflected and the bone crest was surgically prepared as in alveolectomy in man. Then the soft tissues were sutured back over the opened sockets.

3. For each surgically prepared wound, a control was established, consisting of a simple extraction wound on the opposite side of the same jaw.

4. In general, the reparative tissue changes in the simple extraction wounds and the surgically prepared wounds are similar.

5. The closure of epithelium and submucosa in the surgically prepared wounds took place almost immediately after the operation because of the close adaptation and suturing of the mucoperiosteal flaps.

6. In the undisturbed or simple extraction wounds, the epithelium proliferated over the openings of the wounds in from five to eight days.

7. Because of the suturing of the alveolectomy wounds, the regeneration of the fibrous connective tissue took place more rapidly in these sockets than in simple extraction wounds.

8. The formation of bone in the sockets of the surgically prepared jaws was somewhat more advanced than in the control jaws. This was partly due to the reduction of the height of the socket and partly to the suturing of the mucoperiosteal flap.

9. In all surgically prepared jaws, some bone filings were present from the trimming of the bone crest.

10. These bone filings between the periosteum and the surgically prepared surface of the jaw seem to be tolerated by the overlying tissue.

11. Bone filings that accidentally dropped into the clot during the surgical preparation of the jaw acted as centers of ossification. On some pieces of bone filings, osteoclasts were present.

12. The healing phases in the surgically prepared wounds were the same as in simple extraction wounds, but the entire healing process was accelerated because of the immediate closure of the epithelium over the socket.

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THE REDUCTASE ACTIVITY OF VARIOUS MOUTH ORGANISMS*

By LEONARD S. FOSDICK, Ph.D.; HAROLD L. HANSEN, Ph.D., and GEORGE D. WESSINGER,† M.S., Chicago, Ill.

THE etiology of dental caries is a problem that has engaged the attention of clinicians and research workers for years. Although a great number of investigations have been carried out and numerous interesting facts have been elicited, sufficient information is still not available to present a complete picture of this phenomenon. It seems that problems of a specific nature will have to be studied before the answer to this enigma becomes apparent. In view of several theories that have appeared within recent years, it was thought that perhaps a quantitative estimation of the ability of certain mouth organisms to convert pyruvic acid to lactic acid should yield results of interest in connection with the larger problem.

Contemporary investigators in the field of dental caries may be divided into two general groups: those who uphold the systemic approach, in which diet is said to be the determining factor, and those who support the chemoparasitic view, first advanced by Miller[1] and Black.[2]

The Miller doctrine has come to be widely accepted. It postulates the production of certain organic acids, chiefly lactic, by the action of bacteria on carbohydrates retained by the teeth during the mastication of food. This doctrine has been somewhat modified. It has been suggested that the action of the acids is localized by the formation of the so-called mucin plaques, which, according to certain investigators, is of prime importance in this connection. The formation of the mucin plaques has been explained by Kirk: A clump of bacteria become lodged on the enamel and act on carbohydrates, liberating acids. These acids precipitate the mucin from the saliva, carrying food particles with it and, at the same time, gluing the organisms to that particular spot, where their action on food particles is continued, resulting in the formation of more acids, which decalcify the teeth. It is now generally conceded that the source of these acids is the carbohydrates found in food débris, and it has been suspected for years that a high carbohydrate diet may possibly play an important rôle in this disease. It is interesting to note, in this connection, that there is available new evidence[3] that the mucin plaques removed from the teeth are more readily permeated by dextrose than by the buffers of the saliva.

The exact mechanism by which lactic acid and other acids are formed from carbohydrates in the mouth has not yet been demonstrated. The most likely answer to the problem that presents itself is that they are formed through a process of degradation brought about by the continued presence to a greater or lesser ex-

*From the Chemistry Department, Northwestern University Dental School.

†Abstract of the thesis submitted by George D. Wessinger in partial fulfilment of the requirements for the degree of master of science at Northwestern University.

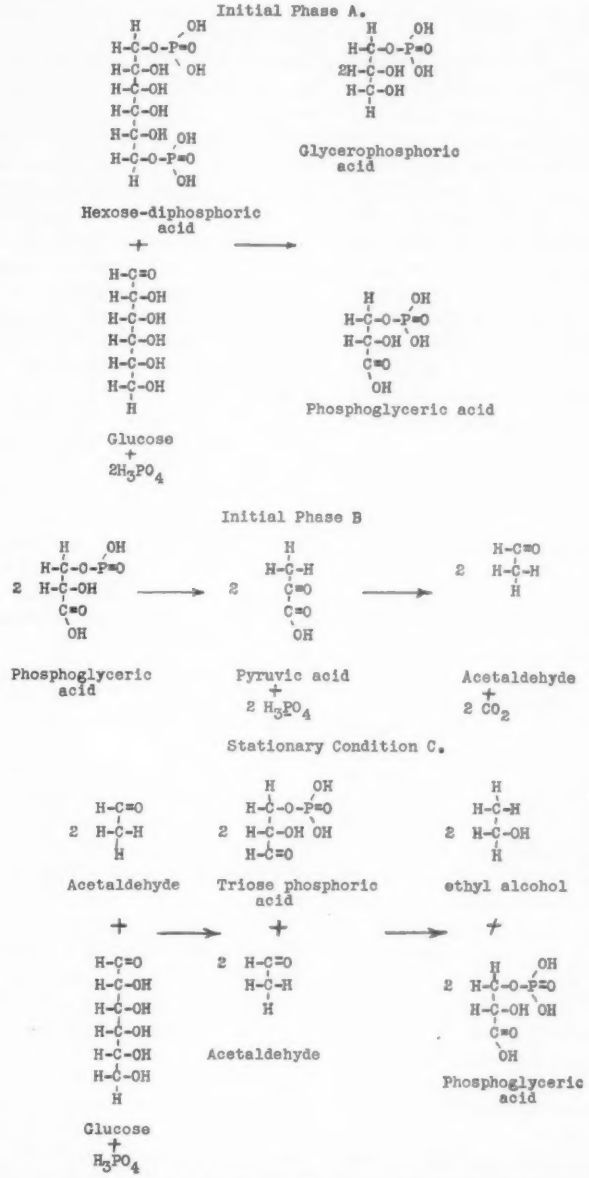
tent of certain organisms in the human mouth. It has been demonstrated[4] that, in ordinary yeast fermentation, lactic acid rather than alcohol can be produced mainly, if fermentation is allowed to take place in the presence of insoluble calcium salts. The degradation of carbohydrates when brought about by yeast has been described by Meyerhof as shown in the accompanying structural formula.

The scheme presented shows the production of alcohol as it occurs in normal fermentation. In abnormal fermentation, in the presence of insoluble calcium salts, in which lactic acid is the main product, it is assumed that when the degradation reaches the pyruvic acid stage, the calcium pyruvate is formed, which somehow prevents its decarboxylation. The reductases in the yeast then transform the keto compound to the hydroxy compound lactic acid.

It is entirely conceivable that the same type of abnormal fermentation may take place in the mouth, the calcium being furnished by the enamel; which results in its destruction. Enamel is now said to be hydrated tricalcium phosphate and, according to Klement and Trömel,[5] its formula is $Ca_{10}(PO_4)_6(OH)_2$. If this should happen to be the case, then it would appear that it is pyruvic acid rather than lactic acid which actually dissolves the enamel since the former is formed first and incidentally is a stronger acid than the latter. If this is true, then the organisms through the agency of their enzymes must reduce the pyruvate to the lactate, since it is the lactate which has been isolated[6] from the stagnant saliva of caries susceptible persons. Furthermore, lactic acid has recently been isolated in appreciable quantities from the dentin of carious teeth.[7] If the actual facts in the case are identical with what has been said above, it then follows that if pyruvic acid is placed under conditions which are likely to be met with in the human mouth, a reduction of pyruvic acid should take place. A quantitative estimation of the ability of a few of the various mouth organisms in pure strain to convert pyruvic acid to lactic acid constitutes the problem presented in this paper.

EXPERIMENTAL DATA

Since the discovery of pyruvic acid by Berzelius, a number of methods for its identification and determination have been reported. All of these methods have been reviewed and discussed by Wendel[8] and hence need not be given here. Recently, Simon and Neuberg[9] have employed 2,4-dinitrophenylhydrazine for the quantitative separation and estimation of acetaldehyde, methylglyoxal and pyruvic acid. Since this method gives fairly accurate results and can be used successfully for determining pyruvic acid in the presence of lactic acid, it seemed to offer possibilities for the problem at hand. This method was used with some samples of pure pyruvic acid in order to determine the degree of accuracy that might be expected. Since it has been shown[10] that pyruvic acid polymerizes on standing and that commercial pyruvic acid may be as high as 30 per cent impure,[11] it was first necessary to prepare some of the pure acid. Crude pyruvic acid was prepared according to the method given in organic synthesis.[12] The acid thus prepared was purified by repeated fractionation under reduced pressure (5-8 mm.). After the fourth distillation, the product was immediately analyzed by the method of Simon and Neuberg, using 2,4-dinitrophenylhydrazine. The results obtained were consistent within 1.12 to 1.25 per cent of the theoretical. Analyses of samples of pyruvic acid in the presence of lactic acid



Degradation of carbohydrates by yeast as described by Meyerhof.

were also carried out without any interference from the latter.

The classic method for the determination of lactic acid involves its separation, usually by ether extraction combined with other means, from interfering substances, its conversion into zinc lactate by boiling with zinc oxide or carbonate and the weighing of the lactate. The purity of the latter can be determined by analysis. This procedure remains a standard method; but it is time-consuming because of the prolonged extraction required to remove lactic acid from other biologic material, and is not suited for the determination of small amounts. Consequently, other methods have been devised which are more rapid and are suited to micro-analysis. These methods usually depend on the oxidation of the lactic acid and estimation of one of the products, acetaldehyde, carbon dioxide or carbon monoxide. The determination of carbon dioxide has a theoretical advantage over the determination of the acetaldehyde, since the aldehyde is capable of further oxidation, while the carbon dioxide is not. Baumberger and Field[13] have measured the carbon dioxide formed by the permanganate oxidation of lactic acid in the Van Slyke gas apparatus. This method presents the advantages of being rapid and also capable of accurate determinations with small samples. When pyruvic acid is oxidized by potassium permanganate, the formation of carbon dioxide results. However, on investigation, the reaction was found to be quantitative, so it was decided to determine the total lactic and pyruvic acid by this method; then to determine the pyruvic acid by precipitating and weighing of the 2,4-dinitrophenylhydrazone. The lactic acid can then be determined by difference.

Because of the large number of species of bacteria that have been isolated from the human mouth, the investigation herein reported had to be limited somewhat in scope. Consequently, six typical mouth organisms were chosen for the investigation. The organisms used were grown in sterile 1 per cent dextrose broth for at least seventy-two hours. The cultures were examined microscopically for contamination and, if it had occurred, the cultures were discarded and new ones started. The organisms were centrifuged for at least twenty minutes at 4,700 revolutions per minute and the supernatant liquid was discarded. The residue was suspended in sterile physiologic sodium chloride solution and the bacteria were collected on porous clay plates. After drying, the organisms were scraped from the plate with a platinum spatula into vials and placed in a desiccator until used. Before they were used, the bacteria were ground to a fine powder in a mortar. Dried organisms were employed so that they could be weighed out and thus the work would be quantitative. The bacteria prepared in this way are obviously not in an active state, but the enzymes contained in them ought to be present and capable of producing their usual reactions.

The exact procedure used for all determinations was as follows: Paraffin-stimulated saliva was sterilized by heating in an autoclave for twenty minutes at 15 pounds pressure. This was done in order to destroy whatever organisms might have been in the saliva so that the effect of one organism in pure culture might be observed. After cooling, some pyruvic acid was added and also enough sodium bicarbonate to make the saliva neutral or slightly acid to nitrazine paper. In this connection, it might be observed in passing that the p_H of normal human saliva is about 6.7-7.0, but it may vary widely from these figures.

Twenty-five cubic centimeters of the

saliva prepared in the above-mentioned way was placed in a large sterile test tube. Approximately 0.2 gm. of tricalcium phosphate (chemically pure) and exactly 50 mg. of dried macerated organisms were added. The tube was then sealed off with a blow torch and placed in a thermostat maintained at 37.5° C. and shaken mechanically for a period of four hours. Another tube was prepared exactly as above described, except that no organisms were added. This tube was used as a control. A tube containing organisms was also prepared as above described and shaken for a period of eight hours in order to determine the effect of time on the reaction.

After shaking in the thermostat for the required period, the tubes were broken open, and the contents placed in centrifuge tubes and centrifuged for fifteen minutes at 4,700 revolutions per minute. Portions of the supernatant liquid were withdrawn for analysis; 2 cc. specimens of the saliva were placed in 50 cc. glass stoppered Erlenmeyer flasks, and 2,4-dinitrophenylhydrazine dissolved in 2 normal hydrochloric acid added in 10 per cent excess. The flasks were then placed in an incubator, where they were allowed to remain for at least ten hours. At the end of this time, they were placed in an icebox to cool before filtering. The precipitate was poured into a weighed porous clay-bottomed crucible, filtered with suction, washed with distilled water, dried in an oven at 110° C. and weighed. Since other substances were likely to be present, which might form a hydrazone, only that portion of the precipitate which was soluble in dilute sodium carbonate was used in calculating the amount of pyruvic acid present. Simon and Neuberg[9] have shown that the 2,4-dinitro-

TABLE 1.—ACTION OF MOUTH ORGANISMS ON PYRUVIC ACID IN SALIVA IN FOUR HOURS

Organism	Trial	*p*H of Control Tube	*p*H of Tube with Organisms	Pyruvic Acid per 25 Cc. in Control Tube Mg.	Pyruvic Acid per 25 Cc. in Tube with Organisms Mg.	Loss of Pyruvic Acid Mg.	Gain in Lactic Acid Mg.	Conversion Per Cent
Yeast (Saccharomyces cerevisiae)	1	6.80	6.90	345.2	266.7	78.5	11.10	3.21
	2	6.90	7.05	502.4	423.0	79.4	13.00	2.59
Sarcina lutea	1	6.75	6.80	493.4	488.3	5.1	1.00	0.20
	2	6.60	6.70	496.3	490.6	5.7	2.10	0.42
B. aerogenes	1	6.80	6.90	529.8	495.0	24.8	5.20	0.98
	2	6.73	6.80	523.2	492.5	30.7	5.00	0.96
B. subtilis	1	6.70	6.75	378.0	328.4	49.6	3.62	0.96
	2	6.60	7.10	515.1	233.8	281.0	88.50	1.72
Staphylococcus aureus	1	6.70	6.70	519.2	518.3	0.9	None	0.00
	2	6.70	6.75	519.2	517.1	2.1	None	0.00
B. acidophilus	1	7.00	7.15	519.3	488.5	30.8	11.20	2.16
	2	7.00	7.10	519.3	490.5	29.0	10.90	2.10

phenyl hydrazone of pyruvic acid may be extracted quantitatively from the corresponding hydrazones of acetaldehyde, methylglyoxal, etc., by the use of sodium carbonate. Duplicate analysis was made on all determinations.

The saliva in each tube was also analyzed for total pyruvic and lactic acid by use of the Van Slyke manometric apparatus. "Check" analyses were made on all determinations.

that all of the pyruvic acid which disappeared did not reappear as lactic acid. The fate of the remaining acid which was transformed is not known with certainty, but several possibilities could be mentioned. Undoubtedly, some of the pyruvic acid was decarboxylized, the formation of acetaldehyde and carbon dioxide resulting. In the case of yeast, the reaction mixture smelled very strongly of aldehyde when the tubes were opened.

TABLE 2.—ACTION OF MOUTH ORGANISMS ON PYRUVIC ACID IN SALIVA IN EIGHT HOURS

Organism	Trial	*p*H of Control Tube	*p*H of Tube with Organisms	Pyruvic Acid per 25 Cc. in Control Tube Mg.	Pyruvic Acid per 25 Cc. in Tube with Organisms Mg.	Loss of Pyruvic Acid Mg.	Gain in Lactic Acid Mg.	Conversion Per Cent
Yeast (Saccharomyces cerevisiae)	1	6.80	7.00	549.6	431.0	118.6	19.4	3.53
	2	6.45	6.60	506.5	423.5	83.0	16.5	3.26
Sarcina lutea	1	6.70	6.80	518.0	508.1	9.9	3.3	0.64
	2	6.65	6.70	526.6	517.6	9.0	2.3	0.44
B. aerogenes	1	6.70	6.85	519.6	481.8	37.8	9.1	1.75
	2	6.70	6.80	519.6	483.1	36.5	7.8	1.50
B. subtilis	1	6.80	6.80	506.5	502.0	4.5	None	0.00
	2	5.70	7.20	507.7	111.6	396.0	106.0	20.90
Staphylococcus aureus	1	6.00	6.00	513.8	502.9	10.9	None	0.00
	2	6.00	6.00	513.8	509.7	4.1	None	0.00
B. acidophilus	1	6.80	6.95	527.4	468.7	58.7	14.2	2.69
	2	6.80	6.90	527.4	473.2	54.2	11.9	2.26

The *p*H of the control tubes and of the tubes with organisms was also determined. For this purpose, the glass electrode was used, since it offers a rapid means of determining *p*H accurately, using only a small specimen of saliva.

RESULTS

The results obtained are indicated in Tables 1 and 2.

It will be noted from the two tables

In analyzing for pyruvic acid in the substrate of these determinations, it was found that all of the precipitate formed by the addition of 2,4-dinitrophenylhydrazine was not soluble in dilute sodium carbonate. The residue after extraction with dilute sodium carbonate was washed with water and then extracted with hot 95 per cent alcohol. The filtrate was partially evaporated and, on crystallization, a yellow compound was obtained,

which melted at 164-165° C. The melting point of the 2,4-dinitrophenylhydrazone of acetaldehyde is given as 164° C. in the literature. All of the alkali-insoluble residue did not dissolve when heated with hot alcohol; which indicated that some substance was present other than the hydrazone of acetaldehyde, since the acetaldehyde derivative is fairly soluble in the above-mentioned solvent. A melting point determination of this alcohol-insoluble residue was attempted. The temperature of the melting point bath was raised to 310° C., and the compound darkened (an indication of decomposition), but never did appear to liquefy. The identity of this derivative is not known. Methylglyoxal was considered as a possibility, but the melting point of the methylglyoxal derivative is reported in the literature as 298° C. Alkali-insoluble hydrazones were also obtained from the substrates containing the other organisms tried, with the exception of *Sarcina lutea* and *Staphylococcus aureus*.

COMMENT

In considering the action of organisms on pyruvic acid, three reactions are possible:

Decarboxylation might occur, yielding acetaldehyde and carbon dioxide:

$$CH_3CO \cdot COOH \longrightarrow CH_3CHO + CO_2$$

Reduction of the carboxyl group might yield methylglyoxal:

$$CH_3CO \cdot COOH + [H] \longrightarrow CH_3CO \cdot CHO$$

This reaction is unlikely. However, methylglyoxal is frequently isolated from fermentation mixtures. Lastly, the keto group might be reduced to the corresponding hydroxy acid, lactic acid:

$$CH_3CO \cdot COOH + [H] \longrightarrow CH_3CHOH \cdot COOH$$

Of these three reactions, only the last would be of direct interest to investigators in the field of dental caries.

Of the six organisms tried, yeast and *Bacillus acidophilus* consistently reduced more pyruvic acid to lactic acid than did the others. Although the amount of lactic acid formed with each of these organisms is roughly the same, the amount of pyruvic acid which disappeared differed rather widely with the two organisms. Of the total pyruvic acid transformed, approximately 15 per cent reappeared as lactic acid in the four-hour period in the case of yeast and an average of 18 per cent for the eight-hour period. With *Bacillus acidophilus*, the percentage of decomposed pyruvic acid which reappeared as lactic was approximately 37 per cent for the four-hour period and an average of 25 per cent for the eight-hour period.

Bacillus subtilis was extremely inconsistent in its action on pyruvic acid. In two determinations, with this organism, pyruvic acid was energetically transformed; while, in two other determinations, it was almost without effect. No reasons are offered for this anomaly. The presence of other organisms is a possible answer, but it does not appear probable, as all cultures were carefully examined for contamination and discarded if such had occurred. It might be mentioned in this connection that *Bacillus subtilis* was used in this laboratory for determinations of phosphatase activity and also for acid production in the presence of starch, dextrine and sugars, and in both cases inconsistent results were obtained.

Of the other organisms tested, *Bacillus aerogenes* showed appreciable activity, and *Sarcina lutea* reduced very little pyruvic acid to lactic and *Staphylococcus aureus* absolutely none.

Some experiments were performed in this laboratory in which pure cultures of yeast were obtained from the mouth and were allowed to act in a mixture of saliva, glucose and powdered enamel.

This mixture was shaken for definite periods of time at body temperature. The saliva was analyzed for calcium before and after shaking and, in all cases, it was found that dental enamel was dissolved, the average amount in twenty cases being equivalent to 22 mg. of calcium per hundred cubic centimeters in eighteen hours. This same procedure was tried with certain other mouth organisms, and it was found that, under these conditions, *Bacillus acidophilus* produced no effect. When a mixture of yeast and *Bacillus acidophilus* was tried, eight tests gave an average decalcification equivalent to 45 mg. of calcium per hundred cubic centimeters. This indicated a symbiosis of the two organisms. This investigation on reductase activity may throw some light on this symbiosis. The increased production of acid in the presence of the two organisms indicates that in the chain of reactions involved in acid fermentation, there may be certain steps that are more rapid than others and that some of these reaction stages are prompted by the presence of yeast and others by that of *Bacillus acidophilus*. The phosphatase activity of the two organisms has been determined, and it was found that the phosphatase activity of yeast was higher than that of any other organism tried, while that of *Bacillus acidophilus* was nil. Apparently, yeast starts the chain of reactions by furnishing the phosphatase required for the formation of hexosediphosphoric acid, while both yeast and *Bacillus acidophilus* contribute reductases, which are required for some of the other reactions.

SUMMARY

1. Another acid, i.e., pyruvic acid, has been suggested as playing an important rôle in the decalcification of teeth, even though this acid has never been isolated as such from human saliva.

2. The reductase activity of these organisms was measured by their ability to transform pyruvic acid to lactic acid in a substrate of sterile human saliva containing insoluble calcium salts.

3. A symbiosis is found to exist between yeast and *Bacillus acidophilus*.

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REVIEW OF THE LEUKOPLAKIA PROBLEM AS RELATED TO THE MOUTH

By S. WILLIAM BECKER, M.S., M.D., Chicago, Ill.

THE body is covered in its entirety by the skin, composed of an epithelial layer (epidermis) and a connective tissue layer (dermis). At the orifices, there is a transition to the various mucous membranes, so-called because they are lubricated by the secretion of mucous glands. At the site of this transition, there is a structure midway between the skin on the one hand and the mucous membrane on the other, but differing from both. It is the so-called mucocutaneous junction. As practitioners of dentistry and oral surgery, you are interested in the mucocutaneous junction of the lip (the vermilion border), and the mucous membrane lining the buccal cavity.

The mucocutaneous junctions and the mucous membranes not only have a structure differing from that of the skin, but also react to chronic irritation in a characteristic manner. This irritation usually results in the formation of white patches known as leukoplakia, sometimes called "smokers' patches."

According to McCarthy,[1] the lesion starts as a red granular sharply defined and slightly sensitive area, becoming slightly whitish gray. It then becomes a bluish white plaque, sharply outlined from the normal mucosa, slightly elevated, and appearing to be pasted on the mucous membrane. It is adherent and cannot be curetted or rubbed off. The patch thickens and becomes dead white. It may thicken still more, and the surface may become elevated and warty, or an ulcer may appear, which is usually the sign of malignancy.

The condition occurs most commonly in men, few cases being seen in women. The patients are usually at or beyond middle life, although we had one case of leukoplakia in a boy aged eighteen. There may be a predisposing factor, since not all persons develop leukoplakia even though the precipitating factors are present.

The lesions may appear at any point on the vermilion border of the lip or on the buccal mucosa, but certain areas are involved more frequently than others, since they are more directly irritated. The most frequent locations are the inner surface of the cheeks (Fig. 1), the tongue (Fig. 2), the hard palate (Fig. 3) and the gums. The location depends somewhat on the cause, which may be local or general. Local causes are irritation from teeth, either from faulty occlusion or from caries, and from tobacco, either smoking or chewing. Faulty occlusion may arise from natural or artificial teeth, and the most common site of this irritation is the cheeks. Other sources of irritation are improperly fitting plates, dental appliances, such as crowns, bridges and lingual bars, and electric currents set up

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between dissimilar metals used for fillings. Substances in dental plates to which the patient is sensitive may produce chronic as well as acute inflammation, possibly resulting in leukoplakia.

Smoking has long been blamed for leukoplakia, especially pipe smoking. It is supposed that the heat from the pipe and the smoke, and chemical substances, such as tar-containing phenolic bodies, are instrumental in its production. Leukoplakia due to smoking may be quite diffuse, may cover one-half of the tongue or the entire hard palate and may be present on the cheeks.

Fig. 1.—Leukoplakia of buccal mucosa in boy aged eighteen.

Fig. 2.—Leukoplakia of tongue associated with syphilis.

According to Prinz and Greenbaum,[2] the use of beverages high in alcoholic content and wine containing tannic acid, prolonged contact with tea and coffee as used by testers, and the ingestion of hot fluids and highly spiced dishes are incriminated as factors in leukoplakia. The habit in certain industries of holding nails and tacks in the mouth also produces chronic irritation.

The chief systemic cause of leukoplakia is syphilis. The two areas most frequently involved are the tongue surface and the region just within the oral commissures. The initial change in the tongue is usually indicated by an interstitial glossitis. The papillae disappear wholly or in part and the tongue has a smooth, scarred appearance. Patches of leukoplakia appear on the shiny surface. When leukoplakia is present as localized patches just within the oral commissures, with few or no patches farther back, it is almost always associated with syphilis.

Atrophy of the papillae of the tongue is said to result[1] from vitamin-A deficiency, and atrophic glossitis occurs in severe primary or secondary anemia. Leukoplakia of the tongue in women is often an accompaniment of severe anemia.

Just what is the significance of leukoplakia? The patient may have noted a slight roughness of the mucous membrane, but many lesions are discovered accidentally in routine dental examinations. There is little discomfort to the patient, beyond the slight roughness,

which may irritate a hypersensitive person. The chief significance of leukoplakia is that it is definitely a precancerous lesion, and serious consideration must be given to its treatment to prevent the formation of cancer.

While the typical patch of leukoplakia usually presents little or no diagnostic difficulty, there are other conditions which may simulate it.[3] These will be considered briefly. A significant fact in this connection is that several diseases ordinarily found only on the skin are occasionally seen on the so-called cutaneous portion of the buccal mucosa, extending from the oral commissure backward. It is the region of a branchial cleft. This is also the site of leukoplakia in many instances. In this region, sebaceous glands, tiny yellowish bodies, are found in more than half of normal mouths, but the condition has been called Fordyce's disease. At times, they are massed in considerable numbers, a yellowish or whitish plaque resulting. The yellow hue and the tendency to grouping in small punctate lesions distinguish the condition from leukoplakia. Other diseases of the skin in which lesions may be present in the cutaneous portion of the buccal mucosa are lichen planus, lupus erythematosus and psoriasis.

Fig. 3.—Leukoplakia of buccal mucosa and hard palate.

Lichen planus offers the greatest difficulties in differential diagnosis. The lesions do not become so thick and whitish as do those of leukoplakia, but are more likely to be a delicate bluish white. They also tend to be arranged in a network (Fig. 4), in contrast to the uniformly whitish plaques of leukoplakia. Examination of the body elsewhere may disclose lesions of lichen planus on the flexor surfaces of the wrist or the center of the shins, and at times on other parts of the body.

Fig. 4.—Lichen planus of buccal mucosa.

Lupus erythematosus presents lesions that are more inflammatory. The center of the lesion may be white, but the border is distinctly reddened, a condition never seen in leukoplakia. Lesions of lupus

erythematosus are nearly always found in certain areas, such as on the face, ears and neck.

Psoriasis, which involves the mucous membrane only occasionally, is characterized by whitish lesions with scales that are easily removed. The patches have the tendency to change from day to day, and the patient has psoriatic lesions on other portions of the body, characteristically on the points of the elbows and knees, on the scalp and over the sacral region.

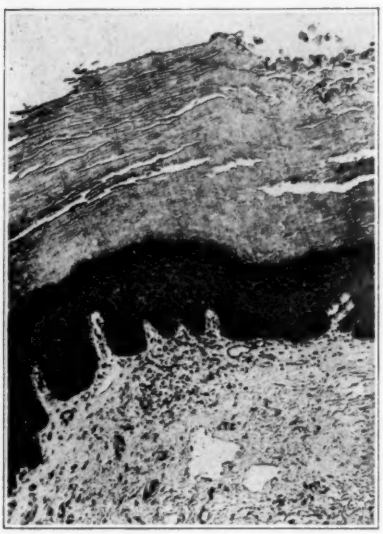

Fig. 5.—Severe leukoplakia of buccal mucosa. (Low power; hemalum-erythrosin-saffron stain.)

Another disease which is characterized by whitish plaques in the mouth is thrush, also known as oidiomycosis. It is more common in infants, but is occasionally seen in adults. On the inner surface of the cheeks are white plaques, rather easily removed, which contain the yeast organism that is responsible for the disease. Placing the scales in 10 per cent potassium hydroxide and heating slightly macerates the epithelial scales so that the hyphae and spores of the yeast are definitely visible.

Other whitish lesions in the mouth that might be confused with leukoplakia are various exudative areas covered by a whitish fibrinous membrane, which, when removed, leaves a reddish oozing surface. The most common of these lesions is the well-known canker sore, commonly known as aphthous ulcer. The lesions recur periodically and are quite tender. They are located about the tongue, cheek and lips. They usually heal without scar formation. Closely resembling canker sores are syphilitic mucous patches, eroded papules, which may be located on the lips or the tongue or about the tonsils. The lesions are usually more abundant than canker sores and not so tender. In any case in which syphilis is suspected, the blood test for syphilis should be made, and any lesion in the mouth beyond the chancre stage will be accompanied by a positive blood reaction.

One occasionally sees bluish white syphilitic lesions on the tongue, which will heal under treatment. They constitute early glossitis, not having progressed to the leukoplakia stage.

We have considered the clinical phase of leukoplakia. What does the condition show on microscopic examination? At first, there is mild inflammation, followed by thickening of the stratum corneum (Fig. 5). The infiltrate, which is of small round cells, is never specific, even when the lesion has appeared as a complication of syphilis. In other words, syphilitic leukoplakia looks the same under the microscope as any other leukoplakia, and it does not heal under antisyphilitic treatment.

The treatment of leukoplakia consists first of all in removing the precipitating causes. If syphilis is present, it should be treated, not with the expecta-

tion of causing the leukoplakia to disappear, but for the purpose of removing any further source of irritation. Smoking may have to be given up in severe cases. Various corrective measures may be employed to eliminate irritation from improperly fitting plates, bridges, lingual bars, etc., and dissimilar metals may have to be removed in order to prevent electrical currents. Amalgam fillings can be replaced by gold.

When we remember the microscopic picture and see that the predominant change is in the epithelium, it is evident that local treatment does not have to produce deep destruction. It is necessary to destroy the epithelium, because there is always the possibility of its becoming malignant and developing squamous cell carcinoma, which is one of the more serious types of cancer. It has been said that cancer originating in leukoplakia is not usually of rapid growth, but I have seen very serious rapidly growing cancer originate in this way. Many patients with leukoplakia have been treated with radium, some with good results. It is difficult to control the effect of radium, and if the lesion is overtreated, the inflammatory change produced thereby may be worse than the initial lesion, as far as the comfort of the patient is concerned. Radium therapy often affords only patchy results, which are not ideal. For the smaller lesions, the electric cautery is efficacious; the effect can be easily controlled, and there can be no serious sequelae. Surgical diathermy affords the same results.

Treatment of a tongue that is entirely covered with patches of leukoplakia is not satisfactory. Surgeons have peeled the entire epithelial covering off the tongue, allowing it to heal in a scar. We have made it a rule to warn patients with this type of involvement to watch the tongue carefully for fissures or ulcerative lesions, and have diagnosed several small cancers by biopsy of these lesions. If these cancers are treated early, results are uniformly excellent.

Prognosis in leukoplakia depends on the degree of involvement and development of the much more serious carcinoma. Patches of mild leukoplakia will regress if precipitating factors are removed, but fully developed plaques remain permanently, although they may become less marked under treatment. If small lesions are cauterized, a scar results which remains as a scar, and does not become a patch of leukoplakia. Other patches will usually develop, if precipitating factors are not removed. After carcinoma has developed, the prognosis is that of squamous cell carcinoma.

SUMMARY

Leukoplakia consists of white patches at the mucocutaneous junctions and on the mucous membranes of the body. They are adherent and cannot be easily removed.

Leukoplakia occurs most commonly in men, and is usually seen at or after middle life.

The causes are local irritation and syphilis. Local irritation may arise from a smoker's pipe; chewing tobacco; natural or artificial teeth in faulty occlusion; badly fitting plates, bridges and lingual bars; electrical currents induced between dissimilar metals used for fillings, and denture material to which the patient is sensitive.

The lesions due to local irritation are at the site of irritation. Lesions due to syphilis are commonly on the tongue and at the oral commissures.

The lesions must be differentiated from those of Fordyce's disease, lichen planus, lupus erythematosus, psoriasis, oral thrush, canker sores and syphilitic mucous patches.

The change is essentially in the epithelium, which has a great tendency to become malignant, squamous-cell cancer, a serious type, resulting.

Treatment must destroy the epithelium, resulting in a scar, which will not become malignant. Treatment of choice is electric cautery or surgical diathermy. Radium is not recommended, because of patchy results and the danger of radium changes in the tissues. Leukoplakia involving the entire tongue is difficult to eradicate.

Biopsy should be made of any ulcerative lesion in order to detect early malignancy. If treated early, the cancers can be easily cured.

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950 East Fifty-Ninth Street.

HEALING OF FRACTURES OF THE MANDIBLE AND ZYGOMA

By K. S. GRIMSON, M.D., Chicago, Ill.

MOST of the recent literature covering fracture of the jaws has dealt with clinical problems, and has covered methods of treatment that are in principle closely related to the mechanical care given fractures elsewhere in the skeleton. The mandible and zygoma are membrane bones derived from the old exoskeleton or dermal bone. These bones develop in membrane, and are, in growth and fracture repair, fundamentally different from the endoskeleton with its endochondral type of ossification and cartilaginous method of fracture repair.

The zygoma is a pure membrane bone, but the mandible in its development becomes more closely associated with cartilage. It is generally accepted that the mandible develops from a dermal bone, the *os dentale,* and that it incorporates in its growth the anterior portion of Meckel's cartilage to form the mandibular canal and that portion of the mandible above the mental foramen and just back of the lateral incisor teeth. Meckel's cartilage, a derivative of the lower portion of the first branchial arch, thus supplies the jaw with a true endoskeleton component. Further development of the mandible reveals other cartilaginous elements at the symphysis, over the coronoid process, at the articulation, and down the posterior border of the ramus. There is some difference of opinion relative to the nature of those cartilages. Fawcett[1] refers to them as accessory cartilage. Schäfer[2] considers them as cartilage of a secondary type. Fuchs[3] suggests that they are remnants of the primordial endoskeleton which have fused with the dermal bone in the process of evolution. Sections through the articular process of

(From the Department of Surgery of the University of Chicago.)

(Read before the Section on Therapeutics, Pathology and Research at the Seventy-Third Annual Midwinter Clinic of the Chicago Dental Society, February 16, 1937.)

an eight-month human fetus show an endochondral type of ossification.

A similar divergence of opinion is present concerning the field of fracture repair. Kölliker[4] (1889) states that complete absence of cartilage in membrane bone fracture healing is not infrequent. Kollar[5] (1896) found cartilage in fractures through the angles of the jaw and concluded that it was related to the secondary cartilage described above. Merlani[6] (1910) stated that in fractures of membrane bone, no trace of cartilage develops. Ribbert[7] (1915) wrote that, at most, one finds in the periosteal callus cartilage cells in large and small islands. Schäfer[2] (1923) studied the course of healing of fractures in the mandibles of ten dogs and described cartilage appearing in six in which the healing was studied later than fifteen days. This he describes as a regeneration cartilage, and it is, he believes, in no way related to the secondary cartilage of the embryonic mandible. Greve[8] (1927) studied similar fractures produced in eleven dogs and, he states, found no cartilage. The fractures in these studies were usually produced in the body of the mandible by a direct blow and were often compound.

In contrast to this description of cartilage by men studying fracture healing,

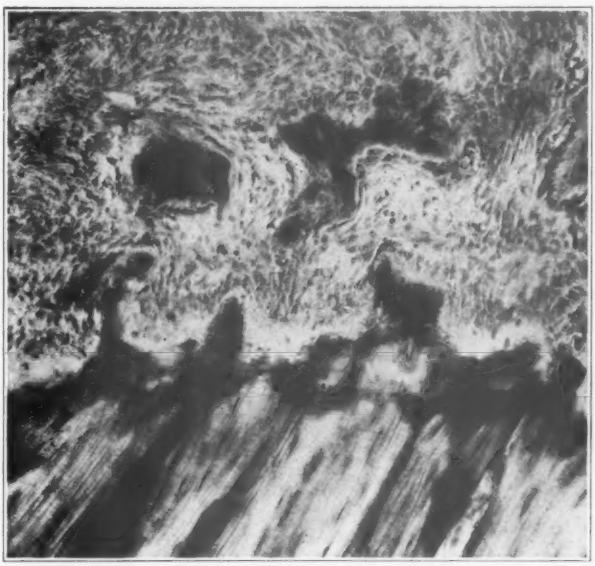

Fig. 1.—New bone developing in fibrous tissue six days after fracture of the mandible. (×170.)

Hans Meyer,[9] Wilhelm Meyer,[10] W. A. Schram,[11] G. Steinhardt,[12] Karoly Balogh,[13] Hans Euler[14] and R. S. Claflin,[15] who have studied the healing of extraction sockets under varying conditions, have described no cartilage. Similarly, cartilage has never been reported in the process of healing of fractures of the vault of the skull. It was decided that further experimental work might aid in the un-

derstanding of membrane bone fracture healing.

METHOD

In seventeen dogs, fractures were produced just back of the body of the zygoma and in the mandible with an aseptic technic, through an external incision without opening into the mouth. Care was taken in the mandible to avoid regions that might have a developmental relationship to cartilage by producing a horizontal fracture above the mandibular foramen and removing the ultimate block from the center of the ramus for microscopic examination. The bones were broken with

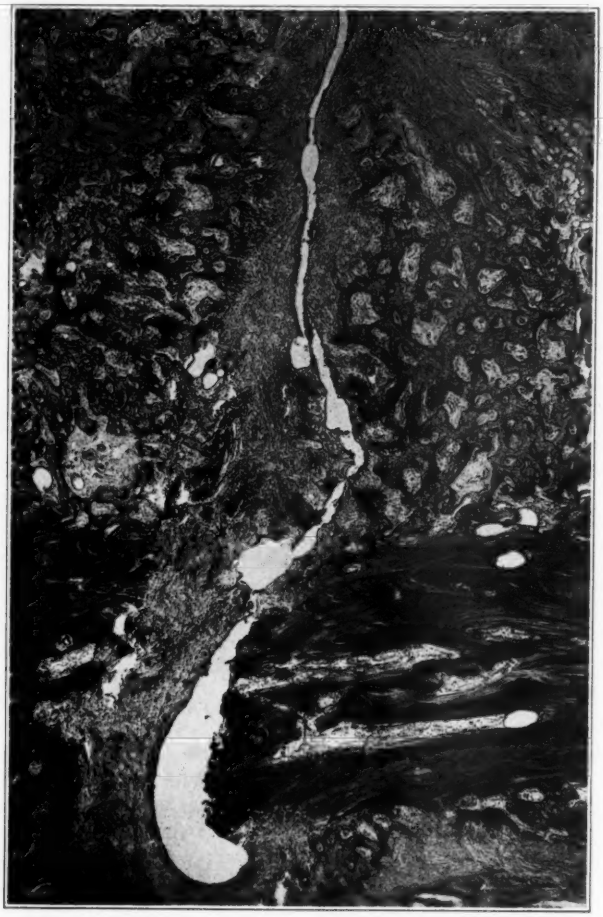

Fig. 2.—Extensive peripheral callus seventeen days after fracture of mandible. No cartilage is present. (×25.)

bone-biting forceps. The final specimens were decalcified, and stained with eosin-hematoxylin stain.

PROTOCOL

Dog 1 died with pneumonia twenty-four hours after the operation. Gross examination revealed a fracture of the zygoma back of the body, and a fracture of the mandible which ran from the posterior margin of the ramus above the mandibular foramen upward to and just in front of the base of the articular process. The soft tissue about the mandibular fracture was lost in the preparation of the sections, and microscopic examination reveals only a few bone fragments clinging to the fracture surfaces. The articular process is included. The articular surface is composed of a fibrocartilage. Beneath this, hyaline cartilage is present and new bone is developing by endochondral ossification.

Sections through the zygoma reveal fracture surfaces separated by interposed skeletal muscle, small bone fragments and a fibrinous clot containing numerous lymphocytes. The periosteum, as it approaches the fracture site, becomes thickened with enlarged and rounded cells.

Dog 2 died with pneumonia three days after operation. There was no evidence of wound infection. The zygoma was fractured just back of the body, and the mandible horizontally across the ramus above the mandibular foramen. Microscopic examination of sections from the mandible reveals several large splinters of bone with extensive loss of nuclei. Periosteal and endosteal layers are both thickened and contain many more spindle-shaped cells than the first specimen. Be-

Fig. 3.—Small amount of peripheral callus seventeen days after fracture of zygoma. (×55.)

neath the periosteum, at some distance from the fracture site, are several large multinucleated cells, a few of which lie in bone lacunae. The fibrinous clot contains fewer round cells and more spindle cells. Sections from the zygoma present the same picture with the exception of the presence of many more large multinucleated cells. In the endosteum bordering dead bone near the fracture site, they are as yet not related to bone lacunae. Further from the fracture site, both at the cortex and bordering the medullary cavities, many of these cells are embedded in bone lacunae.

Dog 3 died with pneumonia four days after operation. The wound was clinically clean. Microscopic examination of the zygoma and mandible reveals essentially the same findings as those for Dog 2. There is less evidence of bone absorption and of periosteal and endosteal proliferation.

Fig. 4.—Peripheral callus of mandibular fracture at twenty-three days. No cartilage is present. (×80.)

Dog 4 was killed on the sixth day after the operation. The wound had remained clean. Sections through the mandibular fracture (Fig. 1) show further condensation of the fibrinous clot into a vascular fibrous callus. Beneath the periosteum near the fracture site, new bone is being laid down by transformation of fibrous tissue into trabeculae that are, in turn, becoming calcified. The endosteum near the fracture site is proliferating. The adjacent fibrous tissue is condensing into whorls that take the shape of trabeculae and undergo calcification to form bone. Fragments of dead bone are enclosed in the fibrous callus. Sections through the zygoma are essentially the same. Occasional large multinucleated cells are present along the dead bone fragments. A few of these are in shallow lacunae.

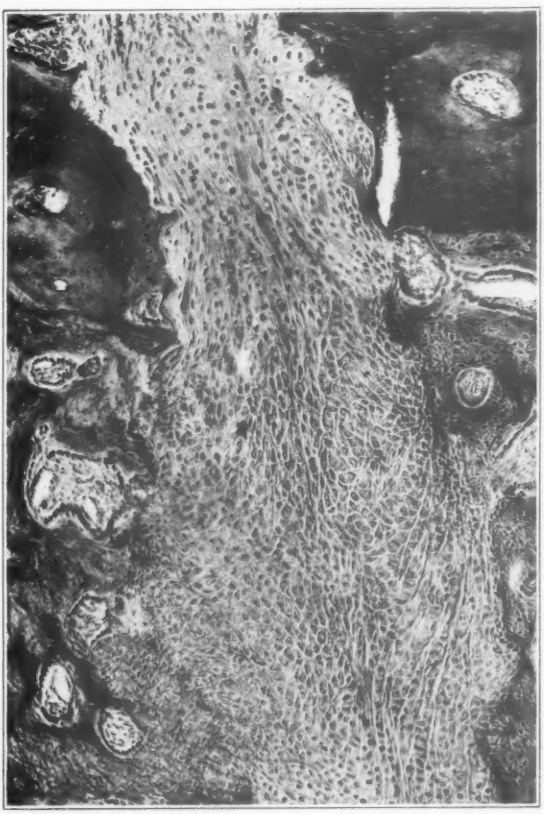

Fig. 5.—Cartilage in peripheral fibrous callus twenty-three days after fracture of mandible. (×85.)

Dog 5, which maintained a clean wound, was killed on the thirteenth day after operation. Sections through the mandibular fracture show extensive peri-

osteal new bone formation near the fracture site. The bone ends are bridged by a dense fibrous callus, which, in one area adjacent to the fracture line, is condensing into fibrous trabeculae that are undergoing ossification. A few large multinucleated cells are present along portions of dead bone. Sections through the zygoma present two fracture lines. One is completely bridged by mature irregular bone trabeculae. The other is bridged by a fibrous callus. Fragments of dead bone in this callus are bordered by large multinucleated cells. Numerous osteoclasts are present along the bone away from the fracture ends.

Dog 6, which maintained a clean wound, was killed on the seventeenth day. Sections through the fracture of the mandible reveal extensive deposits of periosteal new bone that more than double the width of the bone at the fracture site. (Fig. 2.) The new bone deposits as well as the old bone ends are separated by compact fibrous tissue. Several areas in these bone ends are dead and are bordered by large multinucleated cells. One very small island of new bone is present in a condensation of fibrous tissue bordering a medullary cavity. Sections through the zygoma show two fracture sites. The largest gap is bridged with fibrous tissue with a small amount of new bone bordering the marrow cavities. Little periosteal new bone is present. The smaller fracture gap (Fig. 3) is completely bridged by new bony trabeculae, which enclose marrow cavities that are continuous with those of the old bone. A very small amount of periosteal new bone is present along one border. Osteoclasts are present throughout the section on the bone margin.

Dog 7 was killed on the twentieth day after operation. The wound had healed cleanly. Sections through the fracture of the mandible (Fig. 4) show a dense fibrous callus. Some periosteal new bone has been thrown down, and there are several plaques of new bone continuous with the old bone trabeculae. Several large multinucleated cells are present along the old and new trabeculae at the fracture site. Sections through the zygoma show essentially the same conditions.

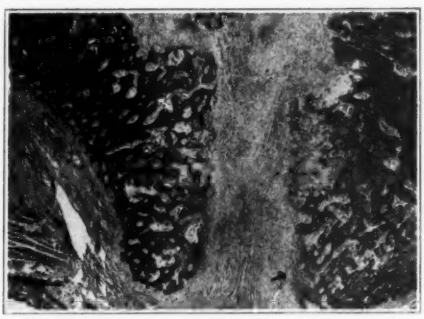

Fig. 6.—Peripheral callus thirty-five days after fracture of mandible; small area of cartilage indicated by arrow. (×18.)

Dog 8 was killed on the twenty-third day after operation. The wound had healed without evidence of infection. Sections through the fracture in the mandible (Fig. 5) show extensive periosteal new bone bordering the fracture site. The fracture ends and callus are separated for the most part by a compact fibrous tissue. Between the periosteal new bone

areas at one side of the fracture, the compact fibrous tissue contains large oval and round cells with clearly defined cell membranes, clear cytoplasm with a faint blue tint and nuclei that stain deeply with hematoxylin. These have the appearance of cartilage cells. Where they border the periosteal callus, there is a gradual transition to new bone that contains a few of these clear round blue cells and has a heavier hematoxylin tint than the remainder of the callus. Ossification is apparently taking place by a transformation of this cartilage into bone trabeculae in a manner quite similar to the formation of new bony trabeculae in fibrous tissue occurring elsewhere in the section. A second section taken through this same fracture line at a different level shows two large islands of these round blue-tinted cells that border the periosteal callus and are separated from each other by a wide fibrous tissue callus.

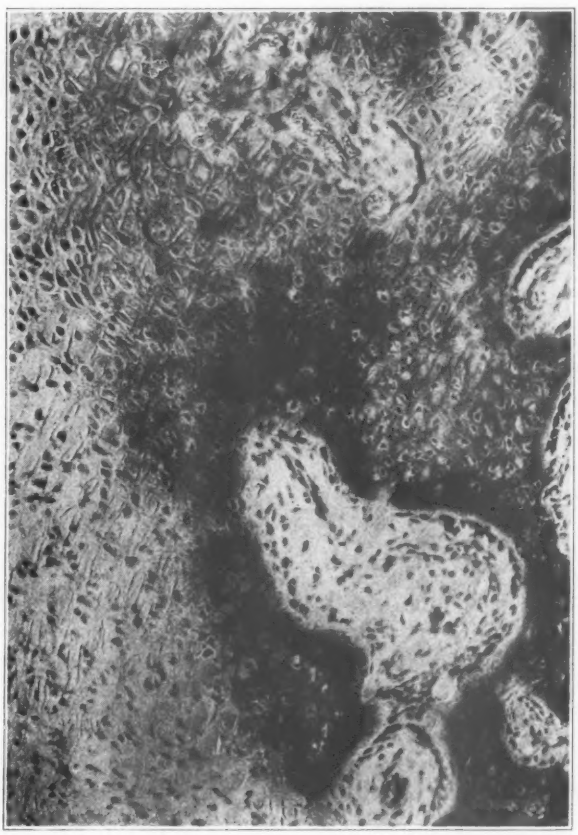

Fig. 7.—Cartilage indicated by arrow in Figure 6. (×160.)

Sections through the zygoma of the

same dog show no suggestion of this type of cell. The bone has been broken in three places. A fibrous callus connects them. There is very little periosteal new bone. The fibrous tissue is in places condensed into trabeculae. A compact layer of new bone is present over some of the fracture surfaces.

old bone trabeculae have developed. They almost bridge the fracture site. No periosteal new bone is present at the fracture line. It has developed along the mandible several millimeters back from the fracture. There is no dead bone in the section and there is no evidence of absorption of living bone. Sections of the zygoma show

Fig. 8.—Bony union forty-four days after fracture of mandible. There is no cartilage. (×35.)

Dog 9 was killed on the twenty-fourth day after operation. The wound had remained clean. Sections through the mandible at two levels show the bone ends separated by a fibrous callus in which new bone trabeculae continuous with the two fractures both of which are bridged by irregular heavy new bone trabeculae with fibrous marrow cavities. Numerous osteoclasts are present along the borders of the old bone.

Dog 10 was killed thirty-one days after

the operation. The wound had healed. Sections through the mandible show a large amount of periosteal new bone on all sides of both fragments, but thickest near the fracture site. A fibrous callus separates the bone ends. Two large pieces of dead bone in it are surrounded by osteoclasts. A small amount of new bone is present about the ends of the broken trabeculae. A large patch of new bone forming in the fibrous tissue and continuous with the periosteal callus halfway bridges the defect. Sections through the zygoma show two fracture planes. One is bridged solidly by new bone trabeculae and the other is bridged by a few irregular trabeculae and a fibrous tissue callus. No material resembling cartilage is present. There is a narrow layer of subperiosteal new bone.

Dog 11 was killed on the thirty-fifth day. The wound was clean. Sections through the fracture of the mandible (Fig. 6) show a wide gap filled with fibrous tissue. In the center of this gap is a piece of dead bone. Osteoclasts in bone lacunae are present along three sides of this piece. The straight cortical side has a layer of new living bone along it with trabeculae extending a short distance into the adjacent fibrous tissue and with occasional lacunae occupied by osteoblasts. A bony callus, twice the width of the original bone, has piled up along one side of each fragment. Fibrous tissue continues the fracture plane through it. At the junction of the bony and fibrous callus, the fibrous tissue is condensing into trabeculae, and new bone is forming. A small group of cells 4 mm. out from the old cortex and between periosteal new bone and fibrous tissue take a distinct hematoxylin blue. (Fig. 7.) The cells in the center of this area are rounded and oval with clearly outlined cell borders, clear cytoplasm with a blue tint and nuclei that stain deep blue. Toward the periphery of this zone, the cells lose color, become elongated and finally become indistinguishable from the fibrous tissue. A section through the fracture of the mandible at another level also shows a similar group of mixed cartilage and fibrous tissue cells.

Sections through the zygoma show a wide fracture gap separated by a fibrous tissue callus. Small amounts of periosteal new bone are present. There are numerous osteoclasts throughout the bone fragments.

Dog 12 was killed forty-two days after the operation. The wound had remained clean. Microscopic examination of the fracture through the mandible reveals a fibrous tissue callus separating the bone ends. A mass of new bone trabeculae borders each fracture end. Between these in the fibrous callus at one side, a large piece of dead bone is being replaced by a process of creeping substitution. A few round to oval cells with clear cytoplasm and a hematoxylin tint are present along a mound of periosteal new bone at least 2.5 mm. from the old bone. These shade gradually into the adjacent fibrous tissue. The fracture in the zygoma is bridged by a few mature bone trabeculae with fibrous marrow.

Dog 13 was killed on the forty-fourth day after operation. The wound had healed. Sections were taken through the mandible at two levels (Fig. 8). One included the mandibular canal and the other passed above it. In both sections, bony trabeculae bridge the fracture defect. A piece of dead bone in the fracture line is being replaced by creeping substitution. Osteoclasts appear in places to be attacking the excess callus. Sections through the zygoma show a fibrous callus partially bridged by bone trabeculae.

Dog 14 was killed on the forty-fifth day after operation. The wound was infected. Sections through the fracture of

the mandible show mounds of periosteal new bone along the cortices of the fractured bones. These tend to approach each other at the periphery of the callus, but are separated by a continuation of the same fibrous tissue that separates the fractured surfaces. No cells have the appearance of cartilage. The zygomatic fracture is bridged by mature bone trabeculae with fibrous marrow.

Dog 15 was killed fifty days after the operation. The wound remained clean. Sections through the fracture of the mandible show the fractured ends separated by a fibrous callus. The new bone, chiefly periosteal, is being actively resorbed. Abundant osteoclasts and numerous bone lacunae are present along the bony callus. No cells resemble cartilage. Sections through the zygoma show the bone ends in close apposition. Again the new bone is being actively resorbed and there is no evidence of a new bone bridge across the fracture ends.

Dog 16 was killed on the fifty-eighth day after operation. The wound had remained clean. Sections through the mandibular fracture show again a fibrous union with active resorption of the new bone and no cells resembling cartilage. Sections through the zygoma show two fracture sites, one bridged by new bone trabeculae and the other by a fibrous callus.

Dog 17 was killed on the sixtieth day after operation. The wound was infected. Two sections at separate levels were taken through the fracture in the mandible. One shows a fibrous union with active resorption of new bone. The other includes a portion of the mandibular nerve and artery at some distance from the fracture site. The fracture itself is bridged by new bone trabeculae that are developing in condensation of the fibrous tissue. Between the cortex of one fragment and the periosteal new bone of another, the fibrous tissue spindle cells undergo a gradual transition into larger round, oval and polygonal cells with sharply defined cell borders, clear faint blue cytoplasm and deeply hematoxylin stained nuclei. New bone is developing in the borders of this cartilage area by a condensation of the cartilage into trabeculae that are undergoing ossification. Sections through the zygoma show a fibrous union with no new bone, and resorption of the fracture ends.

SUMMARY

Healing of fractures of the mandible and maxillae have been studied on the first, third, fourth, sixth, thirteenth, seventeenth, twentieth, twenty-third, twenty-fourth, thirty-first, thirty-fifth, forty-second, forty-fourth, forty-fifth, fortieth and sixtieth days. No methods of immobilization were used. Bony union occurred in three of the older mandibular fractures and in eight of the zygomatic fractures that had close approximation of the bony ends. Five of the zygomas had two fracture planes with impaction at one fracture site and separation at the other. Bony union took place at all of the impacted ends and in one of the separated ends.

The fractures of the zygoma with the ends fixed in close apposition healed rapidly by a condensation of the intermediary fibrous callus into bony trabeculae. There was little or no peripheral or periosteal callus.

Five fractures of the zygoma that were widely separated, and all of the fractures of the mandible, developed a fibrous intermediary callus with little new bone and an extensive peripheral callus with large amounts of new bone. This periosteal new bone extended into the fracture gap by direct transformation of the adjacent fibrous tissue into ossifying trabeculae. This membranous type of ossification was the rule in all of the seven-

teen fractures studied. No endochondral ossification was encountered. In Dogs 8, 11, 12 and 17, areas of cartilage cells were present. They developed between the periosteal new bone and the fibrous callus. In these specimens, most of the new bone was developing in fibrous tissue. This fibrous tissue in the area mentioned underwent a gradual transformation into a fibrocartilaginous tissue. New bone trabeculae were forming by a transformation of this cartilaginous tissue into ossifying trabeculae in a manner quite similar to the membranous ossification seen elsewhere in the section. The mandibular canal with its Meckel's cartilage was not near these fracture sites, since the specimens were taken near the center of the horizontal fracture across the ascending ramus of the mandible.

These facts argue against any relationship between the cartilage in these four fractures and the development cartilage of the mandible. The appearance and peripheral location of this cartilage suggests that it has a very minor rôle in the fracture healing. It apparently develops in the fibrous callus bordering the periosteal new bone. Since this callus is in part derived from the fibrinous blood clot of the early fracture, it probably has the same potential ability for metaplasia to cartilage as it would have had it developed in an endoskeleton fracture. The fact that the cartilage areas were small and were seen only in four of the older fractures proves that they were not essential to the healing process. The zygomatic fractures did not develop an extensive peripheral callus, nor did they develop cartilage.

No method of immobilization was used in this experiment. The relative difference in the amount of motion present in the mandibular and zygomatic fractures may explain the large amounts of periosteal callus and the occasional occurrence of cartilage in the mandibular fractures, and the small amounts of periosteal callus and absence of cartilage in the zygomatic fractures.

CONCLUSIONS

1. Healing of fractures of the mandible and zygoma is essentially intramembranous in type.

2. Small amounts of cartilage may develop in the peripheral callus late in the healing process of mandibular fractures that are not immobilized. These probably originate as a metaplasia of the fibrous tissue callus and probably bear no relationship to the cartilaginous anlage of the mandible.

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PRESENT-DAY PRECISION INLAY INVESTING AND CASTING TECHNIC

By DAVID W. PHILLIPS, D.D.S., Chicago, Ill.

TODAY, the physical principle of delicately regulating the inherent expansion properties of inlay investment to balance the various shrinkages encountered in the casting process, when investing is carried out at existing room temperature by the "control" method, has been established by its successful use by large numbers of dentists to the point where one no longer has to be concerned about the caprices of innovation.

For about twenty years after the discovery of the casting process, we were harassed by the constant severe underexpansion provided by the casting technics then in use, with the result that it was almost impossible to fit properly such castings as large mesioclusodistal and full crown castings.

Therefore, when the wax expansion technics came into use and we found that we could provide sufficient expansion to fit even comparatively large 2 per cent taper metal dies, this new high expansion standard was immediately accepted by the dental profession as correct for all castings, including those for the mouth, regardless of type or size. All castings were supposed to be "precision" if the high expansion found necessary to fit metal dies was uniformly employed.

But, early in my investigative work, I observed that most castings of the type and size that we use in practical mouth work were overexpanded in varying amounts when this high degree of expansion was used.

However, despite the fact that the pendulum had swung too far from underexpansion toward overexpansion, the early workers in wax expansion contributed much indeed to the evolution of casting, for they pointed the way to overcome what had been the great obstacle to precise work up to that time—underexpansion.

As the water bath technics developed, I sought an expansion standard to meet the requirements of practical casting as we carry it out in actual mouth work; that is, the ideal expansion standard between the underexpansion of the old technics and the overexpansion of the wax expansion technics used to fit metal dies.

This expansion standard was determined by regulating and reducing water bath temperatures and was finally pegged at a point nearest the average expansion requirement of all practical mouth castings, a little above the expansion found necessary to fit correctly the types of prepared cavities requiring the least expansion and slightly below the expansion needed in prepared cavities requiring the greatest expansion.

This is the degree of expansion I refer to as meeting average expansion requirements, and it is also the expansion provided by the control system at

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all investing temperatures when the temperature weighing notches of the automatic scale are employed in conformity with the existing investing room temperature.

Because the *modus operandi* of this technic and the research which developed it have already been fully described in previous papers,[1] I shall touch just briefly on the physical fundamentals governing it, in order to make more intelligible a table indicating the expansion variation required for uniform precision by the types of preparations most often used and a simple method to be presented for increasing the security of all castings employed to retain fixed bridgework; after which, the correct investing and casting technic will be discussed.

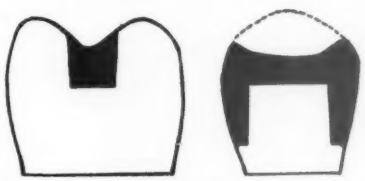

Fig. 1.—Drawings showing dual nature of combination type of casting. Left: Longitudinal section cut buccolingually through center of bicuspid with mesioclusodistal inlay in place. Here, the casting appears as fully enclosed by the tooth structure as a simple occlusal casting, an enclosed or intracoronal type. Right: Longitudinal section of tooth and casting shown at left, but cut mesiodistally through the same point. Here, the same casting appears instead as enveloping the tooth structure and the section could not be distinguished from a full-crown casting of the enveloping or extracoronal type.

PHYSICAL FUNDAMENTALS OF THE "CONTROL" TECHNIC

In this method, a simplified and practical means of casting gold inlays to exact cavity dimensions is afforded though investing is carried out with the pattern at high, low or ordinary room temperature. When the pattern is removed from the warm mouth at about 96° F.[2] and assumes the existing room temperature, it undergoes a considerable dimensional change due to the high coefficient of expansion of inlay wax.

Whether the pattern shrinks well below cavity dimensions when removed from the mouth or is actually expanded above cavity dimensions at high summer temperatures, the resulting inlay, instead of duplicating the varying dimensions of the wax pattern, is always cast to exact cavity dimensions.

In order to attain precision in casting, the shrinkages incidental to the process must always be balanced by an equal expansion.

The two shrinkages for which we must compensate, if investing is carried out at existing room temperature, are (1) the shrinkage of gold, a relative constant of 1.25 per cent and, in addition, (2) the shrinkage of inlay wax from mouth temperature to the particular room temperature existing at the time of investing. This varies; *i.e.*, the cooler the room temperature, the greater the wax shrinkage.

It is evident that the sum of the gold shrinkage constant and the wax shrinkage variable for which we must compensate varies, depending on the room temperature which obtains at the time of investing. Therefore, in the control technic, the compensating expansion of the investment is varied in accordance with the existing room temperature, and investments with progressively greater expansions are provided for investing at lower temperatures.

The probable range of investing room temperatures is between 60 and 115° F. For each 5-degree interval between these two temperatures, an investment is provided with an expansion which compensates for the shrinkage of gold plus the

wax shrinkage from mouth temperature to the prevailing room temperature, thus:

If the room temperature is the same as mouth temperature, there is no wax shrinkage for which to compensate, so an investment is provided which compensates only for the shrinkage of gold.

If the investing room temperature is below mouth temperature, an investment is afforded which compensates for the gold shrinkage plus the shrinkage of the pattern from mouth temperature to the particular room temperature existing.

If the investing room temperature is above mouth temperature, the pattern is actually expanded above cavity dimensions and there is no wax shrinkage for which to compensate. In fact, this wax expansion assists somewhat in compensating for the gold shrinkage. Therefore, when investing temperatures exceed mouth temperature, the investment expansion provided by the "control" technic is slightly less than the shrinkage of gold.

So, irrespective of the dimensional changes of the pattern depending on investing room temperatures, the "control" method affords consistent exactitude by maintaining balance at all times between shrinkages and expansions.

HOW EXPANSION VARIATION OF INVESTMENT IS ACCOMPLISHED

Cristobalite inlay investment has a very high thermal expansion in addition to a normal setting expansion. In fact, it has sufficient expansion properties to compensate for gold shrinkage plus the maximum wax shrinkage of the probable low investing temperature of 60° F.

Thus, cristobalite used alone has sufficient expansion to compensate for the maximum shrinkage demands. Any investment with less expansion would not serve. But as the investing room temperature rises above 60° F., less investment expansion is required and the expansion of cristobalite should be progressively re-

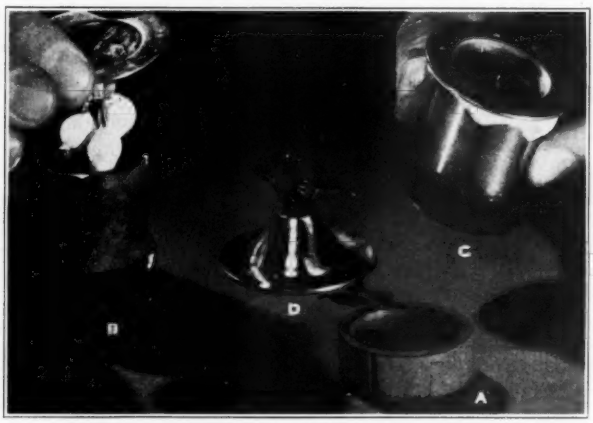

Fig. 2.—A, rubber end cap which is snapped over lower end of ring to form secure bottom so that ring can be filled with investment before painted patterns are introduced (B). C, ring with cap in place and sprue base in position over ring after completion of investing operation. D, multiple type sprue base with four proximoclusal patterns in place for simultaneous investing and casting in same ring.

duced. This is accomplished by mixing with it a material of definitely lower expansion properties, called expansion control powder. As the proportion of control powder is increased, the expansion of the investment admixture is reduced.

This control powder was formulated with a thermal expansion so reduced that, when used alone, it would compensate exactly for the minimum shrinkage demands of the probable high investing temperature of 115° F. Thus, we have two materials, one capable of compensating for the maximum shrinkage requirements encountered at 60° F. investing temperature, and the other meeting the minimum shrinkage requirements of 115° F. investing temperature.

The proportion of cristobalite and control powder to provide the exact expansions for investing at each 5-degree interval between 60 and 115° F. has been determined. The correct amounts are quickly provided in an ideal consistency, a medium heavy painting mix, by the automatic scale which is graduated in these temperature intervals.

The pattern is invested in a single investment mix in a moistened asbestos-lined ring and allowed to set for thirty minutes, then burned out to red sprue-hole heat, and cast immediately.

Despite the fact that it was demonstrated years ago that a comparatively few degrees change in wax pattern temperature effects a considerable change in the dimensions of the pattern, some inlay technics are still based upon the unscientific, mastodonic method of completely ignoring these wax dimensional changes.

Certainly only the water bath technics, which stabilize the pattern investing temperature, and the control method, which controls the investment expansion in accordance with the pattern investing temperature, merit the name "precision."

EXPANSION VARIATIONS ORDINARILY REQUIRED FOR VARIOUS PREPARATIONS*

Expansion Requirements	Pattern Type	Automatic Scale Graduations Employed
Average	Bicuspid mesioclusodistal	At existing room temperature
Less than average	All two-surface (mesioclusal, etc.)	Room temperature +10 degrees
	Bicuspid three-quarter crowns	Room temperature +10 degrees
	Anterior three-quarter crowns	Room temperature +15 degrees
More than average	Molar three-surface (mesioclusodistal, etc.)	Room temperature − 5 degrees
	Full molar crowns	Room temperature −10 degrees
	All one-surface	Room temperature −10 degrees
	Metal dies (mesioclusodistal and full crown)	Room temperature −10 degrees

*Add 10 degrees to the figure determined above for weighing if the casting is to be employed as a bridge retainer, to increase retentivity.

A TABLE FOR EXPANSION VARIATION FOR VARIOUS TYPES OF PREPARATIONS

As stated above, when the scale is employed with the temperature weighing notches conforming with the existing investing room temperature, the correct investment expansion required on the average for all types of castings for precision in practical mouth work is provided. But we find that, to attain uniformly the most exact fit, some preparations require a little less than average expansion and some a little more than average.

In order to provide an easy practical working basis for varying the expansion for the preparations most commonly used, I submit a condensed table, indicating the expansion variations ordinarily required for the various preparations.

For simplicity of application, expansion variation has been translated in the table to existing room temperature plus or minus a certain number of degrees for each type of preparation in weighing materials with the scale.

It should be kept in mind that as the investing room temperature and pattern temperature rise, the pattern is progressively larger, and progressively less investment expansion is required for compensation. Therefore, the scale provides investments with less expansion as the higher temperature graduations are used for weighing.

Thus, investments weighed out on scale graduations *above* a particular investing room temperature afford progressively less than the average expansion required at that temperature. Conversely, investments weighed out on scale graduations *below* the existing temperature afford more than average expansion. The weighing of investments at 5 or 10 degrees above the existing temperature provides just a little less than average expansion. Weighing at 15, 20 and 25 degrees above room temperature affords progressively greater underexpansion.

In the vertical column at the left of the table, preparations are placed in three groups in accordance with their expansion requirements: average, less than average and more than average expansion requirements for precision. In the column at the right beside the specific preparations are placed the number of degrees to be added to or subtracted from the existing room temperature in weighing on the automatic scale.

Note that, after weighing, there is no change whatsoever in the technic: investing and casting are always carried out in the standardized manner because the correct compensatory expansion has been "built into" the investment material.

THE DESIRABLE FIT IN INLAY WORK

Now that we can regulate the dimensions of a casting at will and the control method permits us to secure the particular kind of inlay fit desired, exact, a little tight, or loose, a question that arises frequently is: "What represents the most desirable fit in inlay work?"

When we speak of fit, we must consider (1) the ease of and resistance to insertion, which may be defined as the internal fit, and (2) the marginal adaptation, which in a manner represents external fit. These are the two gages of fit and they are very closely related. But in practice we find that we can make some castings slightly more resistant to insertion and displacement, *i.e.,* more retentive, than others without any apparent variation or impairment of the marginal adaptation. So what represents the best fit in inlay work?

All agree that the marginal adaptation must always be as nearly perfect as possible. But there is less accord of opinions concerning the amount of resistance an inlay should offer to insertion and removal. True, a precise casting always goes to place relatively easily, but many operators prefer their castings uniformly just a trifle snug. In my opinion, both types of fit may be correct. There are instances in which either fit is desirable, the choice depending on the purpose for which the casting is intended.

Let us first consider what represents the preferred fit for ordinary inlay work, individual tooth restorations. A casting for this purpose should go to place easily. It should be pressed to place without

much effort, and most certainly does not require malleting. This kind of fit is dependably consistent with marginal exactitude. A loose casting is undesirable because (1) it has reduced retentivity, and (2) its marginal adaptation is usually imperfect.

BRIDGE RETAINERS

Gaging the value of castings made for abutments represents a slightly different problem. When a casting is to be employed as a bridge retainer, the retention factor becomes increasingly important, and we should use all means at our command to make these castings as resistant to displacement as possible.

In my opinion, lack of complete certainty of retention is a weakness of modern fixed bridgework. For this reason, I recommend making retainers a little more resistant to displacement, and a trifle tighter, than individual inlays. This means that they will require just a little more pressure to seat them. Their increased snugness makes them more resistant to displacement as well as insertion.

But again that does not mean a "driven" fit by any means. Such a fit is practically never correct nor exact. An inlay which requires much force to seat it is the result of poor cavity preparation, pattern distortion, excessive underexpansion, the presence of nodules or "bubbles" on the casting or some other error.

Such castings are nearly always marginally deficient. They not only invite marginal caries, but also may be a potential source of pulp pathosis by squeezing the dentin about the pulp.

If we take just a little advantage of the elastic property of the dentin and increase the frictional resistance of bridge retainers to displacement, we can, without sacrificing anything, definitely increase the security of fixed bridgework.

ANALYZING CASTINGS FOR UNDEREXPANSION AND OVEREXPANSION

We should be able to determine whether a casting is underexpanded or overexpanded by the manner in which it goes to place, granted it is free from tiny nodules or other defects.

It is evident that increasing the expansion makes a simple occlusal casting tighter, but it also makes a full crown casting looser.

Let us analyze all types of castings and formulate one simple rule for expansion interpretation. From the standpoint of interpreting underexpansion or overexpansion, castings fall into three groups, as follows (this is not a cavity classification):

1. The *enclosed type* (so-called intracoronal), in which the casting is enclosed by the tooth structure. All one-surface castings, such as simple occlusal and gingival castings, fall into this group. Obviously, as the expansion is increased, these castings become tighter; but, strangely enough, and this is highly important, they require more expansion than any other type. In fact, in practical casting work, it is difficult indeed to overexpand castings of this type.

2. The *enveloping type* (the extracoronal), such as three-quarter and full crown castings which envelop the tooth structure. Increasing the expansion of these castings has just the reverse effect, making them looser.

3. The *combination type,* parts of which are enclosed by tooth structure as in the enclosed type, and parts of which, in effect, envelop the tooth as in the enveloping type. Nearly all castings except those specifically mentioned above fall into this combination class. For instance, the occlusal part of a proximoclusal casting is enclosed between the buccal and lingual walls of the cavity, but, taken as

a whole, the casting envelops the tooth about two surfaces.

The dual nature of this combination type of casting is most strikingly illustrated in sections cut through the long axis of a posterior tooth with a mesioclusodistal casting in place. Such a longitudinal section cut buccolingually through the center of a bicuspid (Fig. 1, left) reveals the enclosure of the occlusal part of the casting between the buccal and lingual walls of the cavity. Here it appears as a completely enclosed simple occlusal casting.

Another longitudinal section (Fig. 1, right), through the same point, but cut mesiodistally, reveals the enveloping nature of the casting. This section appears much the same as a similar section of a full crown enveloping the tooth. To judge from this section, it is apparent that increasing the expansion of the casting makes it looser.

In this type of casting, we are concerned primarily with providing sufficient expansion to prevent the casting from pinching the axial walls too tightly, which would prevent proper seating.

Because of the great unlikelihood of producing overexpansion in the enclosed occlusal part of the casting as stated above, tightness between the buccal and lingual walls is practically never evident though the expansion of these castings be greatly increased. Thus, increasing the expansion makes the combination type castings progressively looser, and decreasing the expansion makes them tighter and more retentive.

In practical casting, combination type castings behave in the manner of Type 2 castings, which completely envelop the tooth.

Therefore, for all practical purposes we can formulate one simple all-inclusive rule for expansion interpretation: *Reducing investment expansion (and casting dimensions) makes all castings except one-surface castings tighter.* Conversely, increasing expansion makes all except one-surface castings looser.

Of course, errors of any kind in cavity preparation, securing the pattern and casting can also produce variations in the resistance of castings to insertion.

INCREASING THE RETENTION OF FIXED BRIDGES

As all retainers for fixed bridgework fall into the combination type of castings, decreasing the expansion of these castings just slightly below that ordinarily provided for an individual inlay makes them a little tighter in the cavity and more retentive; a factor of great significance to the security of fixed bridgework.

Increasing the retentivity of retainers to any desired degree is simple in the control technic. One merely consults the expansion variation chart to determine the temperature weighing notch that would ordinarily be employed for a given preparation and then adds 10 degrees for weighing if the casting is to be employed as a bridge retainer. This automatically reduces the investment expansion and makes the casting a little tighter by automatically increasing the proportion of control powder slightly.

To illustrate, let us assume that we are investing a three-quarter crown pattern for a cuspid intended as a bridge retainer, and that the existing room temperature is 65° F. For an individual restoration, the chart indicates that we would add 15 degrees to that temperature for this preparation and weigh the materials, using the 80° weighing notches of the automatic scale. But because this casting will be a retainer, we add 10 degrees more and weigh on the 90° graduations instead. Investing and casting are then carried out in the usual manner. Remember, there is never any change in the control tech-

nic under any condition. So, in addition to regulating investment expansion to compensate for investing temperature-dimensional changes in the wax pattern and expansion variation to effect uniform exactitude for different types of patterns, I recommend that we take still greater advantage of the operative niceties made possible by the "control" method for an additional purpose; namely, expansion variation to increase the retentivity of retainers and the security of fixed bridgework.

INVESTING TECHNIC

An error of the early days of casting that persists is the practice of placing the ring over the upright sprue base with its painted patterns, using the base as a loose bottom for the ring, and then filling the ring by jarring or vibration while the ring and base are held together in the fingers.

This is not only hazardous procedure, but vibration causes air bubbles in the mix to rise to the under surface of the patterns, brings the water to the surface in the ring and causes the settling of the denser parts of inlay investments, all of which are mixtures of plaster and refractory materials which vary in density. This produces a thinner mix near the surface and a thicker one near the bottom, as if the mix were centrifuged, and results in uneven expansion.

The filled ring with the pattern within must never be jarred or vibrated under any conditions.

Even though investing is carried out by the hand-painting method, one can take advantage of an expedient originally devised to make machine investing possible, an inexpensive little rubber end cap that snaps over the bottom of the ring (Fig. 2, A). The asbestos-lined ring is then easily filled by slight jarring or vibration without danger to the pattern. Then the inverted sprue base with its painted patterns is gently hand vibrated down to place over the ring (Fig. 2, B).

The ring with its investment and patterns can be transferred from place to place also if necessary without hazard, because it has a secure bottom and the sprue base rests on top of the ring (Fig. 2, C). When the investment is set, the rubber cap is merely snapped off the ring. Another way to accomplish this is to seal the bottom of the ring to a piece of sheet metal with sticky wax, as recommended by Dr. Coy.

THE MULTIPLE TYPE SPRUE BASE

The multiple type sprue base (Fig. 2, D and B), devised to permit the simultaneous investing of several patterns of similar type by machine in one ring, may also be employed for hand investing, though it is necessary to space the patterns more carefully for hand work in order to permit access to all pattern surfaces with the brush. This sprue base does not have holes in fixed positions for receiving the sprue formers, but a large center of soft wax into which the sprue formers may be pressed in any relative position and the patterns spaced for convenience.

The sprue base effects a considerable saving of investment materials and time because several patterns can be invested in one ring at once and cast in one operation. The number of inlays, whether two, four or eight, cast simultaneously in one ring, had no effect on their quality. At clinics, I have shown a residue button, with thirty-one closely grouped castings all perfectly cast in one operation.

The investing machine, "painting," as it does, by extremely delicate vibration under slow controlled movement of the pattern, down into the investment, up for "debubbling" and down again for the

final embedding, permits placing the patterns within a fraction of a millimeter of each other, just far enough apart so that they do not touch.

CASTING TECHNIC

A point of considerable practical significance has come up frequently in discussions of papers on casting, with the questions: "Is there not some mold heat loss in the time interval between the removal of the mold from the oven and the actual casting of the gold?" and "Is it not advisable to preheat the gold before removing the ring from the furnace in order to reduce this interval and consequent mold heat loss?"

When the red-hot ring and mold are removed from the oven with cold metallic tongs and placed in the casting machine, the ring itself loses its heat and redness quickly by both radiation and conduction. But we must bear in mind that we are concerned not with the superficial ring temperature, but with the temperature of the interior of the mold. The mold retains its high-temperature glow and thermal expansion much longer than the ring and sufficiently long to carry out the casting operation, as is evidenced by the continuance of glow down in the sprue hole, because the asbestos liner and the superficial part of the investment mold provide insulation against rapid heat dissipation as it occurs in the unprotected ring.

Accurate tests[3] made with a thermocouple embedded in the mold prove that the mold heat loss is negligible in the time required for casting, if an efficient casting technic is followed. Many still pursue the old method of placing the ring in the casting machine, with the crucible cold, heating the gold and then casting. This requires too much time before the mold is actually cast.

An extra heating of the gold before casting as an expedient to reduce the casting time is also poor technic, because the oftener and longer gold is heated in the presence of air, the greater will be the impairment of its desirable physical properties.

The best procedure, simple and efficient, is as follows: Before removal of the ring from the oven, the blowpipe flame is played on the crucible of the casting machine until the crucible glows brightly. The ring is then transferred from the furnace to the casting machine and the gold melted and cast.

It is surprising how much more quickly the gold can be melted in a red-hot crucible. The reducing flame of the blowpipe is, of course, always used and the gold is well fluxed.

The operator is cautioned against the practice of adding scrap gold, new gold or any other nugget to a residue button in the crucible of the casting machine at the time of casting. This is the wrong place for mixing golds, and the wrong time.

The addition of gold to a button should be carried out as a separate operation before the ring is removed from the oven, on a carbon block with the gold well fluxed, to facilitate mixing of different golds, permit purification and reduce the time consumed in the actual casting operation.

Many are employing electric ovens for burning out, with only an "on" and "off" switch and capable of reaching temperatures far in excess of the correct burning out temperatures, 1300 to 1350° F. Repeated instances have come to my attention wherein the rings have been melted when the burning out was forgotten. Furthermore, the plaster binder of all investments breaks down under excessively high burning out temperatures.

But even with such ovens, it is not necessary to tend the furnace regularly to

determine the condition of burning out, and the furnace door need never be opened from the time the ring is placed in the oven until casting time, except in the few instances when the burning out was started with the furnace still hot from a previous burning out.

It is suggested that the next six or eight times such a furnace is used for burning out, the mold be placed in the cold oven and timed carefully to determine the exact time required to attain red sprue-hole heat under what may be termed average light conditions. This does not mean before a window nor in a dark corner of the laboratory.

When the correct time for burning out has been determined, the interval timer used in developing roentgenograms is set at the time the ring is placed in the cold oven. One can practically forget the burning out until the timer rings the time to cast. This saves the time and attention required in watching for the right degree of burning out, signals to prevent overheating of the ring and mold and provides consistent mold casting temperatures and casting results.

Useful all-purpose furnaces are now available with "high," "low" and "medium" switches, the "medium" of which is controlled to attain and never exceed the correct mold casting temperature, no matter how long it remains turned on.

As long as the mold remains at the fixed casting temperature, the expansion remains the same and the casting can be made at any time the operator desires. With a temperature-controlled furnace, the mold is held at the predetermined correct temperature, and there is no need to inspect it for red sprue-hole heat. This also eliminates all danger of overheating the ring and mold.

CONCLUSION

It must not be considered that simplified, popularized precision casting by the "control" method is necessarily inaccurate science. Actually, it provides uniform exactitude heretofore unobtainable even with the more elaborate technics.

However, I do not wish to leave the impression that all questions in casting have been solved. The science of today is not the science of tomorrow; a point too little emphasized by scientific writers.

The interest of the wide-awake worker is more readily challenged by the reality of unsolved problems than by the myth of definite answers for all casting riddles, however fascinating or plausible the solutions can be made to sound. Accordingly, no attempt is made to conceal the fact that the science of casting is a living, changing, growing one.

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2376 East Seventy-First Street.

STUDIES IN TOPICAL ANESTHESIA. II FURTHER OBSERVATIONS ON THE EFFICACY OF THE MORE COMMON LOCAL ANESTHETICS WHEN USED ON THE GUMS AND ORAL MUCOSA

By M. L. TAINTER, M.D.; A. H. THRONDSON, D.D.S., and S. M. MOOSE, D.D.S., F.A.C.D., San Francisco, Calif.

IN a previous paper,[1] we discussed the general problems of local anesthesia of the oral mucous membranes induced by topical applications. At the same time, we presented in another paper[2] observations made with various solutions of supposed value as topical anesthetics. Those observations have now been extended to include results with thirty-four different solutions and a total of 2,192 individual applications. The object of this paper is to summarize the final results of this study and to indicate the most desirable solutions for clinical use.

METHODS

The methods employed, which were described in a previous paper,[2] consisted essentially of applying the solutions with cotton applicators for about two minutes to the mucosa of the mouth or gums of patients and determining the resulting local anesthesia. Two solutions were tested simultaneously, one being applied on one side of the mouth, the other on the opposite side. Records were kept in each case of the degree of anesthesia, time of onset, duration, irritant properties, local injury to tissues and potency of the agent as compared with the companion solution. The observations were all made and recorded by the operators in the oral surgery clinic, who, since the anesthetics were in bottles labeled only in code, did not know at any time the composition of the solutions in question. This method, known as a "blind-test technic," is useful when subjective factors must be ruled out.

As has been previously pointed out,[2] since the factors of suggestion and subconscious bias are very important in tests of anesthesia on membranes as insensitive as those of the mouth, blank or inactive solutions had to be tested frequently to evaluate, and measure the magnitude of, these factors. Six aqueous solutions of various colors, tastes and odors, but containing no anesthetic agent, were tested, as well as three different alcoholic solutions, as additional controls. A total of 933 observations were made with these controls, data thus being secured which would establish with a high degree of surety the probable importance of subjective factors in the anesthesia. Two anesthetic ointments were tested in a total of seventy-two observations, and twenty-two anesthetic solutions in a total of 1,187 observations. There was, therefore, an average of sixty-six observations with each product, a number adequate to permit reliable conclusions.

(From the Departments of Physiology and Pharmacology and of Oral Surgery, College of Physicians and Surgeons of San Francisco School of Dentistry.)

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RESULTS

In the accompanying table the results obtained are summarized by averages or percentages. The solutions in each group are arranged in approximate order of activity. With the six aqueous control solutions, complete local anesthesia was reported in from 1 to 20 per cent of the cases, or an average of 11 per cent of all the patients tested. Partial anesthesia was reported in from 18 to 51 per cent of the cases, or an average of 32 per cent of all cases. These results indicated that the patients and operators were satisfied that there was some local anesthesia produced by these entirely bland and inert solutions in an average of 43 per cent of the patients tested. The 10 per cent alcohol solution acted very similarly, there being complete or partial anesthesia reported in 44 per cent of tested patients. These results, obtained in 777 patients, show conclusively that the subjective elements of suggestion cannot be disregarded if accurate conclusions are to be drawn. That this was so was established also by the frequency of reports of irritation and hyperemia. Irritation, or burning at the site of application, was reported in 15 per cent of cases tested with blank aqueous solutions, and in 19 per cent of cases tested with 10 per cent alcohol. Hyperemia of the tissues was reported in 8 per cent and 10 per cent of these cases, respectively. Since these solutions may be assumed to be relatively bland and inert, the results indicate that from 15 to 19 per cent of erroneous reports of irritation, or from 8 to 10 per cent of hyperemia may be expected. The results with the definitely anesthetic solutions must, therefore, be corrected by these values in order to determine the effect of the anesthetic agent itself.

Since strong alcohol was required to dissolve some of the anesthetic agents in adequate concentrations, 156 control observations were made with alcohol alone. Some degree of local anesthesia resulted in 78 per cent of the patients, a burning sensation in 39 per cent and hyperemia of the oral tissues in 14 per cent. There was also superficial necrosis in 8 per cent; which showed that 95 per cent alcohol is too caustic a solvent for such solutions.

The two anesthetic ointments were composed of 10 per cent acetanilid, or benzocaine, in petrolatum. The accompanying table shows that they had little effect, particularly in view of the magnitude of the positive results with blank control solutions. While ointments may be of some value for packing sockets where a prolonged liberation of the drug is desired, they seem to be of little value when applied directly to the mucous membranes.

In the group of anesthetic solutions, the first three, *i. e.,* 10 per cent tutocain and metycaine and 20 per cent procaine, in water, were found to be completely inactive, since they caused no more anesthesia than the aqueous control solutions. These three drugs have undoubted anesthetic properties when injected into tissues, but apparently they penetrate through the mucous surface so slowly or incompletely as to be inactive under our conditions of testing. They would, therefore, seem to be useless for surface anesthesia in the mouth.

Cocaine, in 1 and 5 per cent solutions, was also somewhat disappointing. It produced slightly more anesthesia than the controls, but not enough to indicate any real usefulness. Cocaine anesthesia requires a considerably longer time to develop than could be provided for under the conditions. Stronger solutions may be more effective than the solutions employed by us, but some operators find it necessary to use a paste of cocaine crystals in order to get the desired penetra-

COMPARATIVE LOCAL ANESTHETIC EFFICIENCY OF CONTROL AND ANESTHETIC SOLUTIONS APPLIED TOPICALLY TO THE GUMS AND ORAL MUCOSA

Solution	Color, Flavor or Odor	No. of Cases	Degree of Local Anesthesia			Onset of Anesthesia Average Minutes	Duration Average Minutes	Preliminary Irritation		Hyperemia		Sloughs %
			Complete %	Partial %	None %			Yes %	No %	Yes %	No %	
Aqueous Controls												
Sodium chloride 0.9% in water	Red, bitter	81	1	24	75	4.5	4.3	3	97	7	93	0
Sodium chloride 0.9% in water	Green	77	9	18	73	3.3	3.5	9	91	4	96	0
Sodium chloride 0.9% in water	Red, bitter spearmint	147	10	27	63	5.2	3.9	13	87	7	93	0
Liquor alkalinus aromaticus, N.F.	Red, aromatic	70	10	47	43	2.2	3.6	19	81	13	87	0
Sodium chloride 0.9% in water	Green, spearmint	144	20	35	45	2.4	5.2	21	79	8	92	0
Sodium chloride 0.9% in water	Fluorescent	57	7	51	42	2.4	4.6	26	74	4	96	0
Total and averages aqueous solutions		576	11	32	57	3.3	4.2	15	85	8	92	0
Alcoholic Controls												
Alcohol 10%	Red	201	16	28	56	3.0	4.7	19	81	10	90	0
Alcohol 95%	Violet, wintergreen	32	34	38	28	2.2	3.0	45	55	17	83	0
Alcohol 95%	Red, spearmint	124	38	42	20	2.3	4.2	38	62	13	87	10
Total and averages 95% alcohol		156	37	41	22	2.3	3.6	39	61	14	86	8
Anesthetic Ointments												

Anesthetic Ointments												
Acetanilid 10% in petrolatum		36	8	31	61	5.6	4.6	24	76	3	97	0
Benzocaine 10% in petrolatum		36	11	53	36	5.3	8.0	12	88	3	97	6
Local Anesthetic Solutions												
Tutocain 10% in water		53	11	25	64	1.9	2.5	20	80	8	92	0
Metycaine 10% in water	Violet	56	18	27	55	2.1	4.7	29	71	2	98	0
Procaine hydrochloride 20% in water	Red	37	19	38	43	2.3	4.4	19	81	3	97	0
Cocaine hydrochloride 1% in water	Red	40	15	75	10	4.0	8.0	5	95	12	88	0
Cocaine hydrochloride 5% in water	Violet	41	24	39	37	2.2	4.4	17	83	12	88	0
Diothane 1% in water		108	25	43	32	4.5	10.0	27	73	12	88	0
A.D.R. formula*	Cloves	41	26	46	28	1.9	4.4	23	77	34	66	2
Butesin 10% in 95% alcohol		45	42	31	27	2.2	5.4	18	82	12	88	8
"Diothane 5% Compound Solution"	Aromatic	12	50	25	25	1.6	10.0	27	73	9	91	75
Phenol 5% in water	Phenolic	38	32	44	24	2.5	3.0	40	60	15	85	9
Nupercaine 3% in water	Fluorescent	63	35	42	23	2.4	7.0	24	76	5	95	0
Pantocaine 2% in water	Aromatic, sweet	64	31	48	21	2.2	8.6	40	60	5	95	0
Benzyl alcohol 50% in alcohol	Aromatic	61	43	36	21	2.4	3.4	31	69	11	89	4
Orthoform 10% in 95% alcohol		46	52	28	20	2.2	4.3	10	90	13	87	4
Larocaine 10% in water	Green	103	39	43	18	3.0	10.0	22	78	14	86	0
Butyn 10% in 10% alcohol	Green	81	33	50	17	3.8	8.0	7	93	6	94	0

*Benzocaine, 2; benzyl alcohol, 10; oil of cloves, 5 (Accepted Dental Remedies 1935, page 201).

(Continued on next page)

COMPARATIVE LOCAL ANESTHETIC EFFICIENCY OF CONTROL AND ANESTHETIC SOLUTIONS
APPLIED TOPICALLY TO THE GUMS AND ORAL MUCOSA (CONCLUDED)

Solution	Color, Flavor or Odor	No. of Cases	Degree of Local Anesthesia			Onset of Anesthesia Average Minutes	Duration Average Minutes	Preliminary Irritation		Hyperemia		Sloughs %
			Complete %	Partial %	None %			Yes %	No %	Yes %	No %	
"Butyn 10% Topical Anesthetic"	Red, aromatic	54	37	59	4	2.1	3.9	35	65	11	89	0
Saligenin 10% in 30% alcohol		59	39	58	3	2.5	9.6	36	64	16	84	2
Menthol 5% in 95% alcohol	Menthol	36	42	56	3	2.0	14.1	54	46	9	91	19
Chlorbutanol 10% in 45% alcohol	Aromatic	52	44	54	2	2.9	9.3	22	78	6	94	0
Benzocaine 10% in 70% alcohol		61	59	39	2	2.8	10.8	33	67	16	84	12
Phenol 5% in 95% alcohol	Red, phenolic	36	53	47	0	1.9	14.8	43	57	13	87	22

tion through the surface. Since cocaine has an appreciable toxicity in concentrated solutions, and is a habit-forming drug, it should, in dentistry, be eliminated from the armamentarium of topical anesthesia.

Diothane has been introduced as an especially good topical anesthetic. A 1 per cent solution in water was found to have a very low order of efficiency, since one-third of the patients experienced no anesthesia at all, and only one-fourth had complete anesthesia. Consequently, diothane was not much more satisfactory than some of the blank saline solutions. An apparent difficulty with diothane is that it acts very slowly and requires repeated applications to produce satisfactory local anesthesia. This, of course, makes it an impractical agent for dental topical anesthesia as ordinarily used. The manufacturer of this drug has introduced a special solution of diothane called "Diothane 5% Compound Solution," which is said to contain 5 per cent each of diothane and benzyl alcohol dissolved in 50 per cent ethyl alcohol. In our hands, this special solution was only a little more effective than the aqueous solution. However, as the special solution caused nine sloughs, or chemical burns, in the first twelve patients tested, its use was discontinued, and use as a dental topical anesthetic solution was considered impractical.

Butesin is a local anesthetic used primarily for application to burns. It was about as effective as the diothane solutions, *i. e.*, of a low order of efficiency. Since it had to be dissolved in 95 per cent alcohol, there was considerable surface necrosis (burns). This undesirable action, combined with a comparative lack of local anesthetic efficiency, would make it unsuited for topical anesthesia of the intact oral mucosa.

The Council on Dental Therapeutics of the American Dental Association has

suggested a solution for topical anesthesia from among the formulas in Accepted Dental Remedies (page 201, 1935 edition), containing 2 gm. benzocaine, 10 cc. benzyl alcohol and 5 cc. oil of cloves. This did not prove to be highly effective as a local anesthetic for the oral mucosa, since 28 per cent of the patients experienced no anesthesia at all and 46 per cent only partial anesthesia. It produced an inflammatory reaction in one-third of the patients and caused a slough in one patient. Therefore, it seems to be too irritating and not sufficiently effective for general use. It was our impression that this irritation was due to the oil of cloves, since stronger solutions of benzyl alcohol or of benzocaine did not produce this action. When benzyl alcohol was mixed with an equal amount of ethyl alcohol, a more effective solution (50 per cent) was obtained. This caused complete local anesthesia in 43 per cent of the patients and partial deadening of sensation in 36 per cent more; but as there was local tissue damage in one patient out of every twenty-five, the solution was considered more caustic than it should be for optimal activity. Also, it did not cause enough local anesthesia to be completely satisfactory.

Phenol, which is widely known as a local analgesic and antiseptic, can deaden nerve endings, but at the same time may cause necrosis. A 5 per cent solution in water had a definite local anesthetic action, causing about twice as much anesthesia as did the controls; but as this solution produced 9 per cent of sloughs, it was too toxic locally for the best effect. When the same strength of phenol was dissolved in 95 per cent alcohol, a very efficient local anesthetic resulted. There was complete anesthesia in 53 per cent of the patients and at least partial anesthesia in all of the remaining patients. The anesthetic action came on very promptly and persisted. However, this solution would be difficult to use routinely because it caused sloughs, or superficial necrosis, in 22 per cent of the patients, being more potent in this respect than the aqueous solution.

A group of solutions of intermediate local anesthetic activity consisted of 3 per cent nupercaine, 2 per cent pantocaine and 10 per cent larocaine, each dissolved in water, and 10 per cent orthoform in alcohol. These produced some anesthesia in about four-fifths of the patients and complete anesthesia in about one-half of them. There was approximately one patient out of five in whom a topical application of these solutions was completely ineffective. They were not injurious to the tissues at the site of application, with the exception of the orthoform solution, which had a high alcohol content. As all of these anesthetic solutions were relatively slow in action, it is probable that they would be more effective if continued applications were possible. However, since a reasonable speed of action is necessary in practice, it seems that these solutions are not entirely satisfactory for topical use in dentistry.

A final group of solutions comprised those with which local anesthesia was obtained in practically all the patients; that is, complete failure resulted in only one out of twenty-five or more patients. One of these solutions, menthol, 5 per cent, in 95 per cent alcohol, produced local anesthesia only after preliminary intense irritation, and hence was quite unsuitable as a topical anesthetic. In addition, menthol caused sloughs in 19 per cent of the patients, and so can be eliminated from consideration. Butyn, in 10 per cent solution, was very effective. In fact, the "Butyn Topical Anesthetic" (A.D.R.), the commercially prepared solution, with a pleasant odor of rose geranium and attractive color, was found to be the best of the ready prepared solutions. It caused

local anesthesia in all but 4 per cent of the patients and was non-injurious to tissues at the site of application. A 30 per cent solution of alcohol was required to dissolve saligenin, chemically an alcohol of the salicylate group, to the 10 per cent strength used. It failed altogether in only 3 per cent of the patients, but produced complete local anesthesia in only one-third of them. The alcohol used as a solvent was probably responsible for the 2 per cent of sloughs observed. Chlorbutanol, known also as chloretone, was very similar in activity to saligenin, but caused no sloughs.

The most effective anesthetic agent of the entire group was benzocaine, known under its pharmacopeial name as ethyl aminobenzoate. In a 10 per cent concentration, this agent caused local anesthesia in all but 2 per cent of the patients, and anesthesia was complete in almost two-thirds of them. Benzocaine had a fairly long action and did not irritate the tissues at the site of application. Its poor solubility in water necessitated using 70 per cent alcohol as a solvent, and, as a result there were sloughs in 12 per cent of the patients. If these sloughs could be avoided without diminishing the local anesthetic efficiency, benzocaine would approach the ideal among agents for topical anesthesia.

COMMENT

The relative insensitivity of the oral mucosa makes the task of anesthetizing these membranes a comparatively easy one, as far as the degree of nerve depression or insensibility required is concerned. The chief obstacle to the clinical acceptability of almost any of the proposed drugs is that, the mucosa being dense and fibrous, penetration to the nerve endings is very difficult or impossible. Therefore, an effective amount of the anesthetic agent is unlikely to get through, even though penetration of only a small amount is required.

The operator should hesitate after penetrating the anesthetized surface tissue instead of advancing through the entire depth of the mucoperiosteum. At this point, solution may be expelled from the syringe to produce the desired anesthesia in the remaining mucoperiosteum. If this procedure is employed, a satisfactory topical effect will be the result in many more cases than usual. With the solutions now available, only true topical results can be anticipated, although there is, apparently, in many cases a deeper penetration.

The need for deep topical anesthesia cannot be very great for ordinary purposes in dentistry, since 43 per cent of patients and operators thought there was some local anesthesia from perfectly bland and inert salt solutions. However, there can be no doubt that there are times and circumstances when a patient or operator will not be satisfied with the psychotherapy of a nicely colored and flavored salt solution. For such an occasion, it seems that reliance could be placed in the marketed and accepted "Butyn (10%) Topical Anesthetic" (A.D.R.), or in solutions of saligenin, chlorbutanol or benzocaine (which are also described in "Accepted Dental Remedies"), when the solution is to be prepared extemporaneously by a pharmacist. Studies are under way to find a suitable vehicle to permit full utilization of the penetrating power of benzocaine and at the same time avoid the undesired effects of the alcohol used as a solvent. As some progress along these lines has been made, we propose, in our next paper, to discuss the topical application of benzocaine for anesthesia of the anterior palatine papilla.

The control solutions of 95 per cent alcohol produced sloughs, and there were also sloughs with each anesthetic solution when this strength of alcohol was used;

namely, the solutions of phenol, menthol, orthoform and butesin. A 70 per cent alcohol solution of benzocaine was associated with local injury, as was the 50 per cent alcohol of the benzyl alcohol solution, and diothane compound solution. There was even one slough when a 30 per cent alcohol solution of saligenin was used. Chlorbutanol in 45 per cent alcohol and the butyn solutions with 10 per cent alcohol were free from this injurious effect. It appears that not more than 30 per cent alcohol should be used as a solvent, if sloughs are to be avoided. The only nonalcoholic solutions which caused sloughs were the A.D.R. formula, in which the oil of cloves was probably responsible, and the aqueous phenol solution, in which the phenol itself produced this effect, as so frequently happens. Therefore, there is little or no doubt that the causticity of the various solutions was related to the alcohol used to dissolve the anesthetic agents, rather than to the anesthetic agent itself.

SUMMARY AND CONCLUSIONS

1. A total of 2,192 applications of alleged topical local anesthetic agents were made to the gums or oral mucosa of patients. The observations were made by the "blind test technic," the operator observing and recording the features of the local anesthesia without knowing the composition of the solution being tested.

2. Some degree of local anesthesia was reported in 43 per cent of the patients when only bland or inert colored saline solutions were applied. This represents a degree of apparent local anesthesia resulting from the combined influence of suggestion, or psychic conditions, and the low sensitivity of oral mucosa.

3. Control solutions of 95 per cent alcohol caused local anesthesia in 78 per cent of the patients, but, at the same time, produced sloughs or necrosis at the site of application in 8 per cent of patients. Strong alcohol, therefore, seems to be undesirable as a solvent for topical anesthetic solutions.

4. The most effective topical anesthetic solution was 5 per cent phenol dissolved in alcohol, but a 22 per cent incidence of sloughs prevents its general use.

5. The next most effective solutions were benzocaine, chlorbutanol, saligenin and butyn, each in 10 per cent strength, which produced local anesthesia in practically all cases. Benzocaine was the most effective, but had the drawback that it required 70 per cent alcohol as a solvent, and caused 12 per cent of sloughs.

6. Menthol, 10 per cent in alcohol, was very effective, but caused too many sloughs and too much sensory irritation to be clinically useful.

7. Larocaine, orthoform, benzyl alcohol, pantocain, nupercaine, diothane, cocaine and a formula from Accepted Dental Remedies were only partially effective under the conditions. Since the concentrations used were the highest practicable, or recommended, these products are not entirely suited for topical application in the mouth.

8. Tutocain, metycaine and procaine showed no more local anesthetic efficiency than did the aqueous control solutions under the same conditions.

9. The oral mucosa is a relatively insensitive surface where the need of topical anesthesia is not ordinarily very great. When such anesthesia is needed, almost complete abolition of sensation can be obtained by a two-minute application of a 10 per cent solution of benzocaine, chlorbutanol, saligenin or butyn.

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POSSIBLE RÔLE OF RETAINED DECIDUOUS ROOTS IN ETIOLOGY OF CYSTS OF THE JAW

By EDWARD C. STAFNE, D.D.S., Rochester, Minn.

NO doubt the roots of many deciduous teeth remain in the alveoli as a result of fracture during the extraction of these teeth, but most of them probably remain as a result of a transverse resorption through the root, a process which tends to separate the apical portion completely from the remainder of the tooth. When the crown of the tooth undergoes exfoliation or is removed, the apical portion of the root not infrequently remains. The majority of roots which remain after loss of the deciduous teeth are resorbed. Vertical radiopaque lines, or streaks, which are often seen in roentgenograms of the interdental bony system adjoining the bicuspids, are evidence of the presence of tips of retained deciduous roots which have been totally or almost completely resorbed.

To disprove the contention that such roots always disappear, Austin and I previously called attention to the not infrequent presence of such roots in adults. These roots were found in the region of the bicuspids, upper as well as lower, and in persons of all ages. The situations of such roots, in order of frequency, were: (1) distally to the second bicuspid; (2) between the bicuspids and (3) mesially to the first bicuspid. They were more common in the mandible than they were in the maxillae, the ratio being 4:1.

The situation which these roots eventually assume varies from a point where they protrude above the crest of the alveolar ridge to a point beyond the apices of the roots of the bicuspids. Increase in size of the jaws and their growth away from a deciduous root, which retains its original position, account for the great distance between the alveolar crest and the deciduous root. This growth away from the root is characteristic of those cases in which such roots remain in the maxillae, as well as of those cases in which the roots remain in the mandible. In the roentgenogram, it is not unusual to find the images of such roots superimposed on the image of the maxillary sinus. The tips of three deciduous roots that are situated distally to and near the tips of the roots of the maxillary second bicuspids are illustrated in Figure 1. A ground section of the root on the left is shown in Figure 2. The low position which such roots may assume in the mandible is shown in Figure 3, a, in which two of the roots are situated below the roots of the permanent teeth.

Sprawson has called attention to the fact that granulomas, cysts and other sequelae of caries in deciduous teeth are no different from those which are associated with caries of permanent teeth, but are seen less often because the deciduous teeth remain in the jaws only a short time. He says that microscopic examination of granulomas associated with de-

(From the Section on Dental Surgery, The Mayo Clinic.)

(Read before the Section on Therapeutics, Pathology and Research at the Seventy-Third Annual Midwinter Clinic of the Chicago Dental Society, February 16, 1937.)

ciduous teeth and granulomas associated with permanent teeth revealed that the masses of epithelium were more abundant and larger in the former than in the latter. What Sprawson has said about deciduous teeth may also be applied to retained roots of these teeth, which, like retained roots of permanent teeth, are probably a potential source of cysts that are lined with epithelium.

Several roots which have been partially erupted between the permanent teeth, and which have been associated with a chronic inflammatory condition of the gingivae, have been noted. In a few cases, a rarefaction of bone has been observed around deciduous roots which were situated below the crest of the ridge. Such a condition is shown in Figure 3, b, a roentgenogram of the bicuspids of a patient twenty-nine years of age. The deciduous root, which apparently was undergoing resorption, was surrounded by an area of rarefaction. There was no outward evidence of the presence of this root. There was no redness nor swelling, and no break in the epithelial attachment could be found, although one probably would suspect that there was a communication with the oral cavity, judging from the roentgenographic evidence. Removal of the root was advised, but the patient would not submit to having this done. Therefore, it was not possible to determine whether the tissue surrounding the root was merely inflammatory or whether it was a cyst. The spreading of the roots of the bicuspids suggested that it might be a cyst. The possibility that a cyst could develop in association with retained tips of deciduous roots had occurred to me, but it is only recently that a cyst which probably developed from such a source has come to my attention. It must, of course, be understood that in speaking of deciduous roots and remnants of such roots as a potential source of cysts, the presence of epithelial cell rests is inferred.

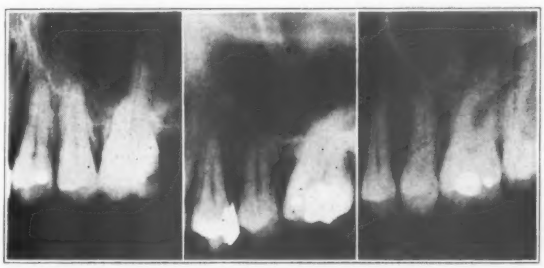

Fig. 1.—Three deciduous roots above roots of bicuspids.

Case 1.—A woman, aged seventy-six, came to the Section on Dental Surgery at The Mayo Clinic, November 7, 1935, with a swelling on the buccal aspect of the right side of the mandible, in the region of the premolar teeth. The swelling had been noted for several months. There was no history of pulpitis or periapical infection in any of the teeth in the right side of the mandible. A deep periodontal pocket was present, but this was found between the first and second molars. Roentgenographic examination of this region revealed a cyst about 2 cm. in diameter, situated below the two bicuspids and the first molar (Fig. 4). There was a marked recession of the pulp chambers, a finding which can be expected at seventy-six years of age, but the teeth responded to tests for vitality. A small radiopaque nodule, which was identified as the tip of a deciduous root, was situated

near the apex of the second bicuspid. This tooth had been forced out of alinement. A mucoperiosteal flap was raised and the thin layer of bone was removed to allow complete enucleation of the cyst, which was accomplished with ease by means of blunt dissection. The tip of the deciduous root came away with the cyst. A view of the cavity revealed that the apices of the roots of the first bicuspid and the first molar were not attached to the cyst. The second bicuspid was removed because of uncertainty as to whether it was responsible for the formation of the cyst, but it was found to have a vital pulp. The first molar was also extracted because of the advanced pyorrheal involvement. Microscopic examination revealed an inflammatory cyst which was lined with squamous epithelium.

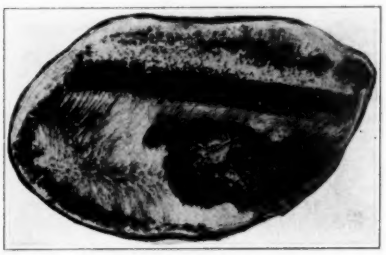

Fig. 2.—Ground section of fragment of deciduous root encapsulated in hyperplastic cementum. (× 20.)

The contents consisted of a thick yellow material.

From the evidence obtained in this case, both from the preliminary examination and from observations at the time of operation, it seemed reasonably certain that this cyst did not have its origin in the permanent teeth. If it is assumed that cysts lined with epithelium do develop from retained deciduous roots that are sufficiently large to be readily seen in the roentgenogram, is it possible that epithelial remnants which have been associated with retained roots that have been completely resorbed are a source of such cysts?

Orban called attention to the fact that every epithelial island in the jaw is not a remainder of the sheath of Hertwig and showed epithelial rests in the interdental bony septum between the lower first and second bicuspids of a fifty-year-old human being. He said that the epithelial islands were remains of the dental lamina, or were remainders of a supernumerary tooth which did not develop beyond the stage of an epithelial bud. He also called attention to the possibility that such epithelial islands later develop into epithelial tumors of the jaw. The fact that the epithelial rests shown by Orban were situated in the interdental bony septum between the bicuspid teeth suggests that they possibly may have been rests that at one time were a part of the periodontal membrane of the root of a deciduous tooth. Almost all retained deciduous roots are found in the region of the bicuspids. Since some of these roots are situated beyond the apices of the roots of the permanent teeth, it is also possible that such epithelial islands may be found at a considerable distance from the crest of the alveolar ridge.

Blum reported an epithelial cyst of obscure origin, which was situated between a lower cuspid and the first bicuspid. The boundaries of this cyst did not involve the roots of the approximating teeth. Is it not possible that the source of this cyst could be epithelial remnants once associated with the periodontal membrane of the mesial root of a lower first deciduous molar?

I have noted several cysts similar to that reported by Blum. The following case is an example of the occurrence of such a cyst.

Case 2.—A man, aged forty-five, was first seen in the dental section, July 22, 1931. At that time, dental roentgenograms were made, but nothing unusual was noted in the region between the lower right bi-

cuspids (Fig. 5, a). He returned again for dental roentgenologic examination November 17, 1936, and the roentgenogram at that time revealed a round area of radiolucency between the lower first and second bicuspids (Fig. 5, b). Pain was not present, and the adjoining teeth gave a normal response to the test for vitality. A diagnosis of epithelial cyst was made. Removal was advised, as it was felt that complete enucleation of this small cyst could be accomplished with ease and without injury to the teeth. Besides, early removal of such a cyst is no doubt a means of avoiding destruction and loss of adjoining teeth. The cyst was removed November 19, 1936, through an opening made in the cortical plate of bone on the buccal surface. A thin-walled cyst which was confined to the cancellous portion of bone was readily enucleated. While it was situated close to the roots of the adjoining teeth, it was not in any way attached to them. Microscopic examination revealed that the cyst was lined with squamous epithelium (Fig. 6). Reexamination of the roentgenogram that was made in 1931 did not reveal any evidence of a root. The appearance of the

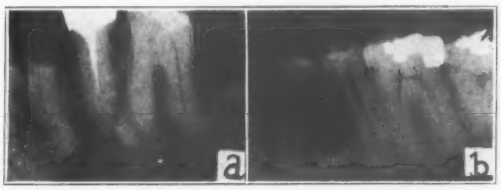

Fig. 3.—a, Two deciduous roots situated below roots of permanent teeth; b, fragment of deciduous root around which there is a loss of bone.

Fig. 4 (Case 1).—Cyst and tip of deciduous root near end of root of second biscuspid.

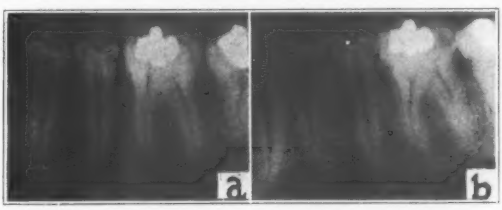

Fig. 5 (Case 2).—a, Roentgenogram made July 22, 1931; b, roentgenogram made November 17, 1936, showing cyst which has developed in interdental bony septum between first and second bicuspids.

bone suggested that there had been a retained deciduous root which had undergone resorption.

A larger cyst, which was situated in the region of the bicuspids, developed in the following case. The etiology of this cyst is also obscure.

CASE 3.—A man, aged sixty-seven, came to the Section on Dental Surgery, August 26, 1932, complaining of pain in the left mandible, in the region of the bicuspids. A painful swelling on the buccal surface had first been noticed two months previously, and had been lanced at that time. At the time of the examination at the clinic, swelling was present and there was a slight drainage from the opening which had been made. There had been no discomfort or pain associated with the cuspid or premolar teeth prior to the onset of the present complaint. The color of the teeth was normal; no fillings were present, and there was no evidence that caries had ever been present. The second bicuspid failed to respond to tests for vitality, and was painful on percussion. None of the permanent teeth had been lost, and all of them, including the third molars, were fully erupted and in normal alinement. There was no evidence of pyorrhea. Roentgenographic examination revealed what appeared to be two cysts (Fig. 7), one spherical and about 1 cm. in diameter situated between the bicuspids and a larger one which extended from the second bicuspid, anteriorly, to the left lateral incisor region.

Fig. 6 (Case 2).—Cyst lined with squamous epithelium. (× 100.)

The cyst was removed August 29, 1932. The buccal surface of the bone overlying the cyst in the region of the bicuspids had been destroyed by the recent acute infection. After the mucoperiosteal tissues had been dissected, the opening in the bony wall had to be enlarged only slightly to allow complete enucleation of the cyst. The posterior and buccal walls of the cyst itself had been almost completely destroyed by infection. They unfortunately were torn to such an extent during removal that it was not possible to determine whether two separate cysts actually were present, as had been suggested by the roentgenographic appearance. A view of the bony cavity from which the cyst had been removed showed a small well-rounded compartment and a larger compartment, which communicated with each other. This finding suggested that there were two separate cysts which may have developed independently of each other or that the second cyst may have been a daughter cyst of the first to appear. Microscopic examination of

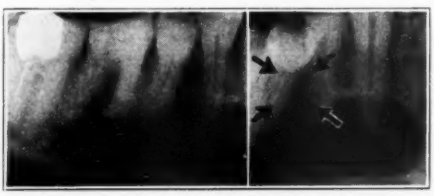

Fig. 7 (Case 3).—Cyst. The smaller area of spherical radiolucence is indicated by arrows.

the cyst revealed a lining of squamous epithelium.

The second bicuspid, which had not responded to vitality tests, was extracted. It was found that the pulp had degenerated, but it was felt that degeneration of this pulp had not taken place until some time shortly before the onset of the pain and swelling two months prior to the removal. In other words, it is my belief that the cyst was responsible for the death of this pulp, and that the second bicuspid had probably not been a factor in the formation of the cyst. That the cyst may have had its origin between the roots of the bicuspids is suggested by the roentgenographic evidence. The exact etiology is, of course, problematic, and the association of epithelial remnants with fragments of deciduous roots is suggested only as a possible origin.

COMMENT

Case 1 is submitted as evidence that, in rare instances, epithelial-lined cysts of the jaws probably develop from retained deciduous roots. The absence of evidence of such roots in the roentgenogram of cysts of obscure origin does not necessarily rule them out as an etiologic factor because they may not be of sufficient size to be seen, or they may have been completely resorbed either prior to, or after, the formation of the cyst.

It is possible that at least some of the epithelial islands found in the jaw, particularly those in the region of the premolar teeth, are those which at one time were associated with the roots of the deciduous teeth. Judging from the deep position of the retained deciduous roots in adults, it is also possible that some of these epithelial islands may be situated beyond the roots of the permanent teeth, and that they may account for some of the cysts which apparently are not associated with the permanent dentition.

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INJURIES TO THE TEETH AND SUPPORTING STRUCTURES CAUSED BY VARIOUS ORTHODONTIC APPLIANCES, AND METHODS OF PREVENTING THESE INJURIES

By O. H. STUTEVILLE, B.S., D.D.S., M.S.D., Evanston, Ill.

THIS study is not presented with the purpose of condemning or supporting any particular orthodontic appliance or system of treatment: it was undertaken for the purpose of demonstrating the changes that take place in the teeth and supporting tissues when orthodontic force is applied to the teeth. The specimens presented are from dogs and human beings in whom the teeth were moved with a measured amount of force, active for a known distance. The experiments varied in length of time. From the findings, it is possible to interpret the histologic picture of clinical cases.

Edward H. Angle defines orthodontia as "that science which has for its object the prevention and correction of malocclusion of the teeth." Abram Hoffman defines orthodontia thus:

> . . . a biomechanical science which has for its object the prevention and correction of malocclusion of the teeth and the harmonizing of the structures involved, so that the dental mechanism produced will be best suited for the human organism as a whole. In theory or in practice, it is a study of growth and development linked with physical and mechanical principles.

Science is defined by Webster as: "Knowledge as of general truth or particular facts obtained and shown to be correct by accurate observation and thinking." We see from the foregoing definitions that orthodontia is a very extensive field, and since it is both a science and an art, it is based on certain known facts and principles. The treatment of malocclusion, or the practice of orthodontia, is not a procedure of "trial and error." A definite plan must be carried out to assure satisfactory results.

An orthodontist is one who practices orthodontia. He has thorough knowledge of the anatomy, physiology and pathology of the structures which make up the masticatory mechanism. He is one who is able to make an accurate diagnosis of and prognosis in malocclusion. He can construct and adjust an orthodontic appliance, thus correcting malocclusion with the minimum trauma to the teeth and supporting structures.

As long as the law permits the treatment of malocclusion by one without adequate training, the laboratory method of treatment will be continued. One has only to consult some of the dental trade journals to see the number of laboratory technicians who will make a diagnosis and a prognosis, construct appliances and give directions for treatment after merely looking at a set of models. Can any one make a diagnosis from a set of models? What does the laboratory man know about the anatomy, physiology and pathology of the teeth and supporting

(Read before the Section on Orthodontia at the Seventy-Third Annual Midwinter Clinic of the Chicago Dental Society, February 16, 1937.)

structures? Our own state publication carries the advertisement of an orthodontist (?) who will make a diagnosis and a prognosis, construct appliances and outline the course of treatment after looking at a set of models and x-ray pictures of the unerupted teeth. Is this orthodontia? From the definition given, it is not! This is the greatest evil that orthodontists have to combat, and undoubtedly the patients who are treated by these methods receive many permanent injuries, such cases perpetuating in the minds of the laity the idea that orthodontic treatment is not beneficial.

An orthodontic appliance is a mechanical apparatus that exerts force on the teeth, which either moves the teeth or prevents them from being moved by other forces. The following tooth movements are obtainable by the use of orthodontic appliances: buccal or labial, lingual, mesial, distal, occlusal and apical and torsion. There may be a combination

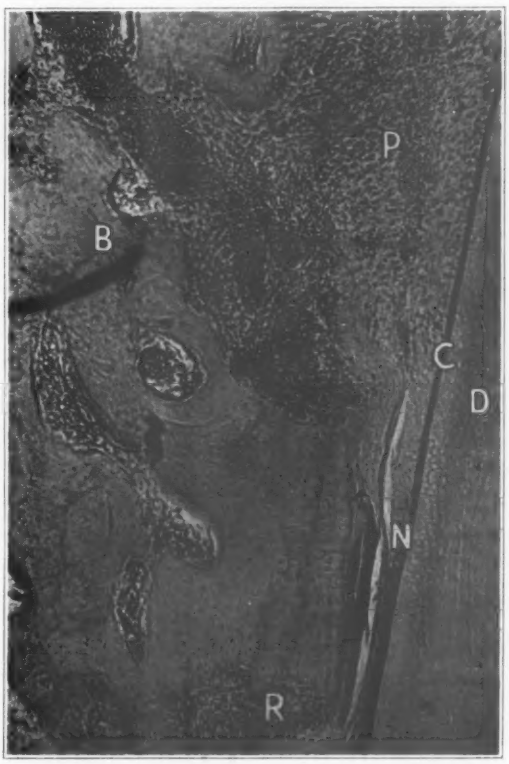

Fig. 1.—Labial alveolar crest region of upper second incisor of young dog: D, Dentin; C, cementum; B, peridental membrane; N, necrotic peridental membrane; R, undermining resorption; B, bone.

of two or more of these movements. The best orthodontic appliance is the one which will correct the malocclusion with a minimum of trauma to the teeth and supporting tissues, and with the minimum number of adjustments. Simplicity of appliance is desirable, but efficiency should not be sacrificed for simplicity.

All of the appliances now in general use are, in the hands of certain men, efficient, or they would have been discarded. There is no appliance that will overcome malocclusion without correct adjustments. Although it is not a difficult task to move teeth, it requires a certain amount of orthodontic knowledge and judgment to move teeth from an abnormal position to a normal position with a minimum amount of trauma to the teeth and supporting structures and a minimum number of adjustments of the appliances. Therefore, we see the futility of the treatment of cases by the "trial and error" method, so often employed when there is a lack of proper case analysis.

Unfortunately, the orthodontist cannot produce a force so light as that which causes the tooth to erupt into its position in the arch. Therefore, in every orthodontic case that is treated by mechanical appliances, there are certain tissue changes brought about which are pathologic. It has been the general tendency during the last few years, among the leaders in orthodontia, to try to reduce the amount of damage caused by orthodontic appliances by decreasing the

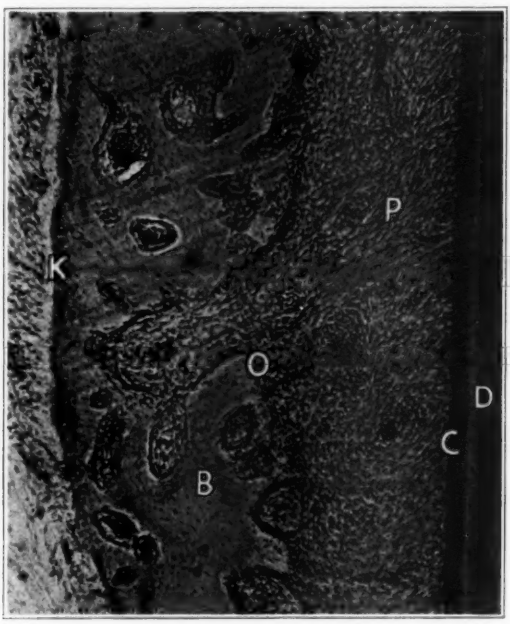

Fig. 2.—Upper second incisor of young dog, labial crest region: D, Dentin; C, cementum; P, peridental membrane; O, osteoblast; B, bone; K, new bone.

amount of force produced by the appliances and by increasing the time elapsing between adjustments. The slight injury to the teeth and supporting structures during the process of correction of malocclusion by the trained orthodontist is justified because it is the lesser of two evils. On the one hand, the child goes through life with a deformed dental mechanism; on the other, he is given a normal mechanism with slight injury to the teeth and supporting structures during the period of treatment.

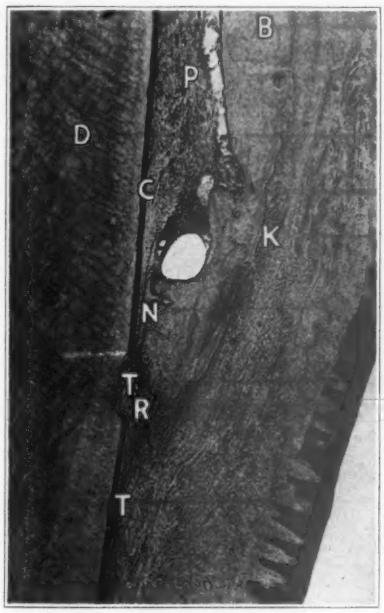

Fig. 3.—Buccal alveolar crest region of upper first bicuspid of child thirteen years old: D, Dentin; C, cementum; P, peridental membrane; N, necrotic peridental membrane; T, tooth resorption; R, undermining resorption; B, old bone; K, new bone.

The injuries which may be caused by orthodontic forces are those to (1) the peridental membrane, (2) the surfaces of the roots, (3) the alveolar bone, (4) the gingivae and (5) the pulp.

1. INJURIES TO THE PERIDENTAL MEMBRANE

The possible injuries to the peridental membrane by orthodontic forces are:

(a) A squeezing of the peridental membrane between the surface of the tooth and the alveolar bone, which inhibits the flow of the blood in the vessels in the pressure area. This results in asphyxia of the tissue and, if the pressure is maintained long enough, necrosis ensues.

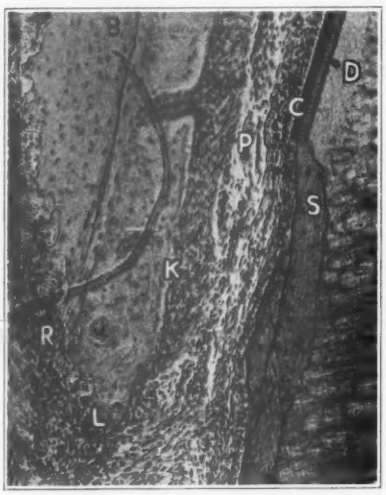

Fig. 4.—Buccal alveolar crest region of upper bicuspid of child thirteen years old: D, Dentin; C, cementum; P, peridental membrane; S, secondary cementum repair; K, new bone; B, old bone; R, bone resorption; L, osteoclast.

(b) Sudden heavy force causing tearing of the peridental membrane fibers on the side of tension. When the teeth are moved by a light auxiliary spring and the inclined planes of the opposing teeth interfere with the movement of the teeth,

there may be a tension and a pressure on each side of the teeth, causing tearing and crushing of the peridental membrane fibers on both sides, which results in a loosening of the teeth owing to the detachment of important groups of peridental membrane fibers.

2. INJURIES TO THE SURFACES OF THE ROOTS

The injuries to the surfaces of the roots are resorption of the cementum and dentin, which apparently results from the squeezing of the peridental membrane between the tooth and the alveolar bone, causing an injury in the peridental membrane, followed by a hyperemia in the areas above and below the injured, usually necrotic, peridental membrane. These hyperemic areas are manifested by undermining resorption which removes the obstructing alveolar bone. At the time that the alveolar bone is being resorbed, the surface of the tooth is also resorbed. These resorbed areas are present in an extremely high percentage of teeth which are moved orthodontically.

It is safe to say that root resorption is produced in 99+ per cent of all cases of malocclusion that are corrected by orthodontic appliances. The position of the root resorption depends on the type of movements and the character of the force applied. In a simple tipping movement by an auxiliary spring, the resorbed areas are at the alveolar crest on the pressure side and on the opposite side of the apical surface of the root. Secondary resorption is produced on the root surface in the

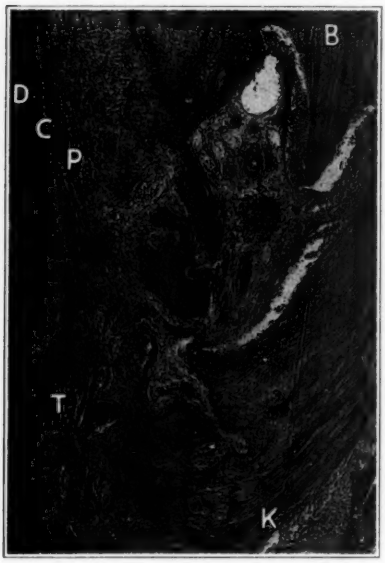

Fig. 5.—Upper first bicuspid of child fourteen years old: D, Dentin; C, cementum; P, peridental membrane; T, tooth resorption; B, bone; K, new bone.

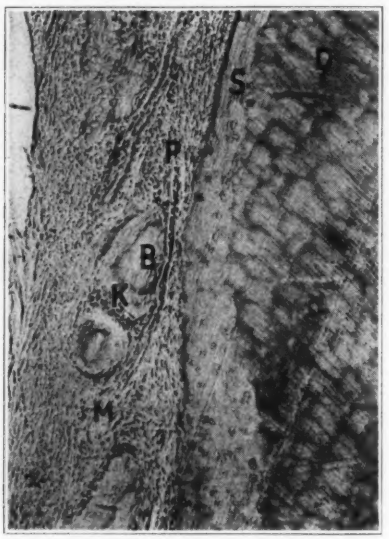

Fig. 6.—Buccal alveolar crest region of lower first bicuspid of child fourteen years old: D, Dentin; S, secondary cementum; P, peridental membrane; B, old bone; K, new bone; M, perforation of alveolar process.

areas diametrically opposite to the area of primary resorption. The secondary resorption results from the "jiggling" that is caused by the forces of the inclined planes during mastication. With more stable tipping appliances, such as those used when the teeth are attached to stable arches by ligatures or bands, the arch does not permit jiggling and the secondary areas of resorption are not produced. The resorbed areas do not show up in the roentgenogram unless the resorption near the apex is extensive enough to reduce the length of the root, which occasionally happens when there is much movement of the apex during the course of treatment.

With root-moving appliances, when the apex is moved more than with tipping appliances, most of the resorption is near the apex on the pressure side, and this area is more liable to involve the apical end of the root. The area, therefore, will be shown by the x-rays.

3. INJURIES TO THE ALVEOLAR BONE

The injuries which are sustained by the alveolar bone during orthodontic treatment are:

(a) The reduction of the height of the alveolar crest.

(b) The thinning out or complete elimination of the alveolar wall.

The alveolar crest is shortened by the rapid tipping of the teeth, the bone not being allowed to return to normal before the force is renewed. Thinning of the alveolar wall occurs when the tooth is moved bodily so rapidly during the expansion that the alveolar bone on the buccal or labial surface is obliterated and the buccal or labial surface is covered only by soft tissue. The density of the alveolar bone depends to a certain degree on the amount of functional stress placed on it. Therefore, in rapid expansion, there is danger of extreme thinning or elimination of the labial or buccal wall by the removal of functional stress

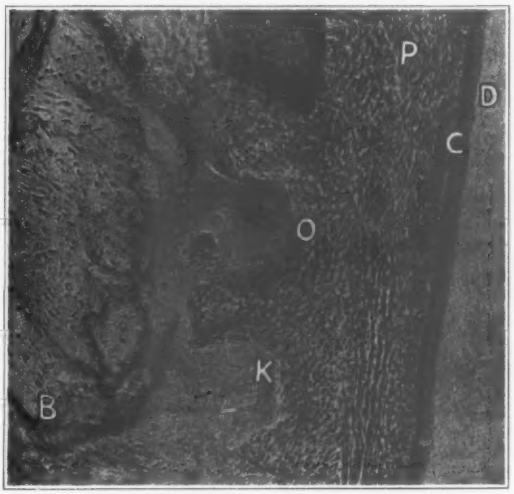

Fig. 7.—Upper first bicuspid of child thirteen years old; lingual arch: D, Dentin; C, cementum; P, peridental membrane; O, osteoblast; K, new bone; B, old bone.

through the force exerted by the appliance.

4. INJURIES TO THE GINGIVAE

Injuries to the gingivae during orthodontic treatment are caused by improperly fitting bands, by ligatures cutting into the gingivae or by such accessory attachments as auxiliary springs impinging on the gingivae. Food particles may lodge around parts of the appliance in contact with the gingivae and cause irritation to the gingivae. All of these injuries can be prevented by the use of properly designed and constructed appliances, which do not permit the injury of the gingivae by any part of the appliance; and the injury by food particles can be prevented by thorough cleaning of the teeth after every meal.

5. INJURIES TO THE PULP

The character of the pulp tissue is such that it does not have much resistance to injury. The injuries to the pulp that are caused by orthodontic treatment are the result of shutting off of the blood supply or of hyperemia of the pulp from jiggling of the tooth during mastication, after it has been loosened by the detachment of a large number of the peridental membrane fibers in the course of movement. Jiggling after the tooth has been loosened may result in tearing or injury of the vessels entering the apical foramen. Another injury may be caused by squeezing of the apex, in the region of the apical foramen, against the bone, thus shutting off the blood supply to the pulp.

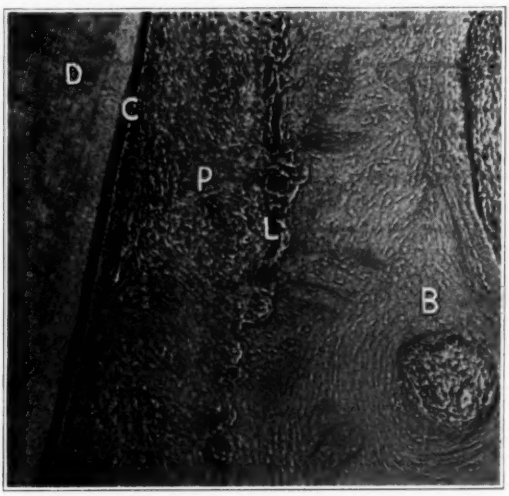

Fig. 8.—Buccal alveolar crest region of tooth shown in Figure 7: D, Dentin; C, cementum; P, peridental membrane; L, osteoclast; B, old bone.

There are relatively few pulps that become gangrenous during the course of orthodontic treatment and in most of the cases showing degeneration of the pulp, there is a history of accidental trauma which will account for the death of tissue. Oppenheim shows degenerative lesions in the pulps of teeth which were treated orthodontically. As he does not

show control teeth, his findings are unsupported.

The labial alveolar crest region of the upper second incisor of a young dog is shown in Figure 1. The tooth was moved buccally by an auxiliary spring which exerted a force of 120 gm., active through 2 mm. over a period of fourteen days. The peridental membrane has been squeezed between the tooth and alveolar bone, the blood supply to the peridental membrane thus being shut off, asphyxia and necrosis resulting. An undermining resorption is taking place in the bone both apically and occlusally to the necrotic area of the peridental membrane. The peridental membrane space apically to the necrotic area is of normal width. The alveolar bone in the necrotic area is acting as a fulcrum to the tooth. An undermining resorption is removing the alveolar crest in the area of the fulcrum. This process causes a shortening of the buccal alveolar bone. There is slight evidence of bone building on the labial surface of the bone. Marked hyperemia is evident both apically and occlusally to the necrotic area.

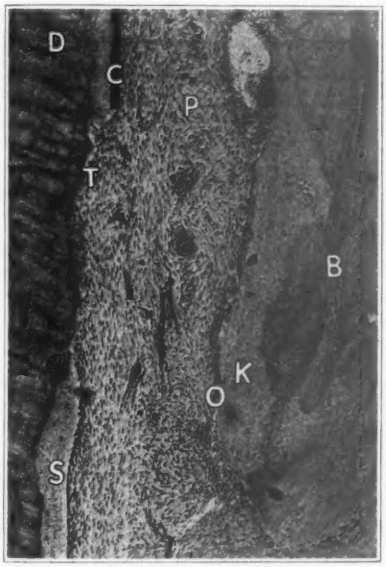

Fig. 9.—Upper first bicuspid of child fourteen years old: D, Dentin; C, cementum; T, tooth resorption; S, secondary cementum; P, peridental membrane; K, new bone; B, old bone; O, osteoblast.

Fig. 10.—Upper first bicuspid of child fourteen years old: D, Dentin; C, cementum; P, peridental membrane; L, osteoclast; B, old bone; K, new bone formation.

Figure 2 shows the upper second incisor of a young dog. This tooth was moved labially by an auxiliary spring exerting a force of 120 gm., active through 2 mm. over a period of twenty-one days. The section shown here is from

an area similar to that shown in Figure 1; and the conditions of the experiment were the same except that the duration of time was twenty-one days instead of fourteen. There is no evidence of necrosis or injury in the peridental membrane. Marked osteoblastic activity is evident, both on the peridental membrane surface and on the labial surface of the alveolar bone. The alveolar bone is much thinner than is normal. The crest of the

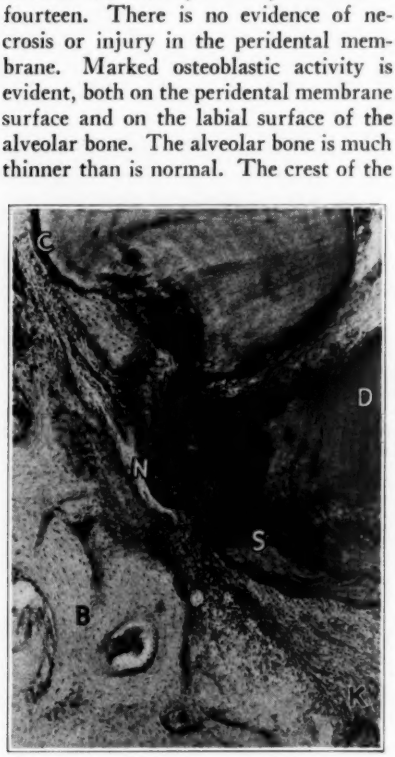

Fig. 11.—Apical region of third premolar of young dog: D, Dentin; C, cementum; S, secondary cementum; N, necrotic peridental membrane; B, old bone; K, new bone.

alveolar bone shows marked bone growth, which is reestablishing the original height of the alveolar crest.

This section would have appeared the same as Figure 1 had it been taken at the end of two instead of three weeks. In Nature's attempt to relieve the obstruction and permit the tooth to move, there is over-resorption of the alveolar bone, which is being built back to reestablish its normal width; which demonstrates the inherent tendency of the peridental membrane to maintain a certain width.

The buccal alveolar crest region of an upper first bicuspid of a child thirteen years old is shown in Figure 3. The appliance consisted of an 18-gage lingual arch with a 24-gage auxiliary spring. The spring exerted a force of 100 gm., active through 1.5 mm. The tooth was moved 0.8 mm. buccally in twenty-nine days. There was a 12 gm. force active through 0.6 mm. at the termination of the experiment. This section shows the tooth pressed against the alveolar bone, with necrosis of the peridental membrane in the crest area resulting. An undermined resorption is taking place both apically and occlusally to the necrotic area of the peridental membrane. At the tip of the crest, both the bone and the surface of the root are being resorbed. Occlusally to this area, a small area of resorption just passes through the cementum; this indicating the original height of the alveolar crest. There is a little new bone formation on the buccal surface of the alveolar process.

Figure 4 shows the buccal alveolar region of an upper first bicuspid of a child thirteen years old. The appliance consisted of an 18-gage lingual arch with a 24-gage auxiliary spring attached to the tooth by a stainless steel ligature. The spring exerted a force of 100 gm., active through 2.5 mm. in a lingual direction. The tooth moved 1 mm. lingually in twenty-nine days. There was a 5 gm. force active through 2 mm. at the termination of the experiment. This section shows a large resorption area on the surface of the root which penetrated the dentin and has been repaired by secondary cementum formation. The peridental membrane appears normal. The alveolar crest appears markedly shortened, as its

highest point is much below the highest point of the resorption area on the surface of the root. The new bone formation is not in long spicules. There is resorption of the buccal surface of the alveolar bone. The resorbed area on the surface of the root was undoubtedly produced by the jiggling of the tooth, caused by occlusal interference during mastication.

Figure 5 shows the upper first bicuspid of a child fourteen years old. The appliance consisted of an 18-gage lingual arch with a 30-gage auxiliary spring. The spring exerted a force of 5 gm., active through 1.5 mm. in a buccal direction. The tooth moved 0.8 mm. in fifty-one days. There was a 2 gm. force active through 0.5 mm. at the termination of the experiment. This section shows the buccal alveolar crest region. There is a large resorbed area on the surface of the root in which no repair is taking place. The peridental membrane is apparently thinner than normal. Resorption is taking place on the peridental membrane side of the alveolar process. There is slight evidence of new bone building on the buccal surface of the alveolar process. This section demonstrates that even a light force may produce root resorption when there are other forces interfering with the action of the orthodontic forces. This tooth occluded with the lower teeth.

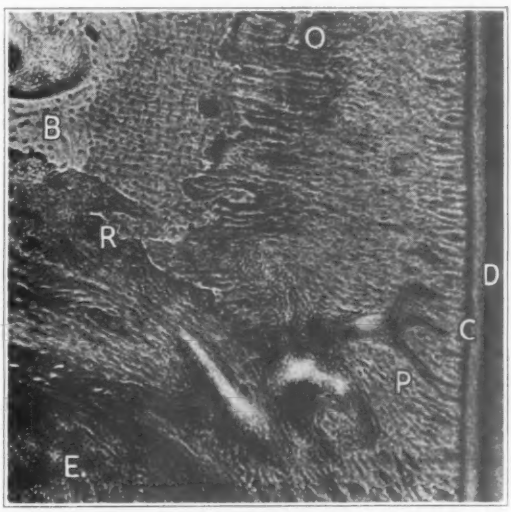

Fig. 12.—Lingual alveolar crest region of upper second incisor of young dog: D, Dentin; C, cementum; P, peridental membrane; O, osteoblast; R, bone resorption; B, old bone; E, round-cell infiltration.

Figure 6 shows the buccal alveolar crest region of a lower first bicuspid of a child fourteen years old. The appliance consisted of an 18-gage lingual arch with a 27-gage auxiliary spring. This spring exerted a force of 16 gm., active through 2 mm. in a buccal direction. The tooth moved 0.8 mm. in twenty-one days. There was a 4 gm. force active through 0.2 mm. at the termination of the experi-

ment. This section shows marked resorption of the surface of the root, which has been repaired by secondary cementum formation. The peridental membrane space is extremely narrow. There is a thinning of the buccal alveolar process, with numerous perforations in the process. Resorption is taking place on the peridental membrane surface of the bone and new bone building on the buccal surface of the process. This section demonstrates that the tooth has been moved bodily owing to the counteraction of the orthodontic force by occlusal forces. This section also demonstrates that light forces may produce root resorption when they are interfered with by other forces.

Figure 7 shows the upper first bicuspid of a child thirteen years old. The appliance consisted of an 18-gage lingual arch with a 24-gage auxiliary spring. This spring exerted 100 gm. of force, active through 2.4 mm. over a period of twenty-nine days. The tooth was moved buccally. There was an 8 gm. force active through 0.2 mm. at the termination of the experiment. This section is of the lingual alveolar crest region. The peridental membrane appears normal. There is no injury to the surface of the root. There is new bone formation on the peridental membrane surface of the process with the spicules arranged perpendicularly to the surface of the root. The new bone formation is thicker at the crest than farther apically, this indicating that the tooth was tipped buccally. An elongation of the crest further indicated that the tooth was tipped.

The buccal alveolar crest region of the tooth in Figure 7 is shown in Figure 8. There is no injury to the surface of the root in this section. The peridental membrane space appears about normal in width. There is a marked osteoclastic activity on the peridental membrane surface of the alveolar process, which indicates that the tooth was still moving buccally. This tooth did not occlude with any teeth in the lower arch. Thus, there was no interference with the orthodontic force and there was no resorption on the surface, this indicating that the tooth had been moved biologically.

Figure 9 shows the upper first bicuspid of a child fourteen years old. The appliance consisted of a 19-gage labial arch. The tooth was ligated to the arch with a steel ligature which exerted a force of 120 to 150 gm. active through 0.2 to 0.3 mm. The force was reactivated six times at fourteen-day intervals. The tooth was extracted twenty-eight days after the last adjustment. The tooth was moved 1.1 mm. in eighty-two days. The tooth occluded with the lower bicuspids, and the occlusal interference caused it to move bodily. This section shows the buccal crest. There is a markedly resorbed area on the surface of the root which has begun to repair by secondary cementum formation. The peridental membrane fibers are not formed in distinct groups. There is new bone formation on the buccal surface of the process and on the tooth side of the process, the latter indicating that no force was being exerted by the appliance at the time of removal, and that the peridental membrane space was being adjusted to its normal width. There were resorbed areas on both the buccal and the lingual roots in the pressure areas of the peridental membrane near the apices.

The upper first bicuspid of a child fourteen years old is shown in Figure 10. The appliance consisted of a 19-gage labial arch. The tooth was ligated to the arch with a steel ligature exerting a force of 150 to 200 gm., active through 0.15 to 0.2 mm. The force was reactivated six times at fourteen-day intervals. The tooth was removed fourteen days

after the last adjustment. As the tooth occluded with the lower bicuspid, the force of the appliance was counteracted by the forces of the inclined plane during mastication. This caused the tooth to move bodily. The section shows the buccal alveolar crest region. The peridental membrane is thin, and there is osteoclastic activity on the peridental membrane side of the alveolar bone. New bone formation is taking place on the buccal surface of the alveolar bone. The bone in the bifurcation of the roots indicated that the tooth had moved bodily. Since there was no resorbed area on the surface of the root, it can be assumed that this tooth moved biologically.

The apical region of a third premolar of a young dog is shown in Figure 11. The appliance consisted of an 18-gage lingual arch with a 24-gage auxiliary spring. The spring exerted a force of 120 gm., active through 2 mm. over a period of fourteen days. The spring slipped up on the cingulum, which caused the pressing of the tooth into the alveolus at the time that it was being moved buccally. This section shows a necrotic area in the peridental membrane in the region of an apical foramen. We see from this that if such a situation should be produced in the human tooth, it is possible that the pulp would be strangulated, with resultant degeneration of the pulp. Human teeth usually have only one apical foramen, while the teeth of the dog have several.

Figure 12 shows the lingual alveolar crest region of an upper second incisor of a young dog. The tooth was moved labially by a labial arch, the tooth being ligated to the arch. This section shows injury of the gingiva caused by the ligature cutting into the tissue. There is a marked round-cell infiltration in the area of the injured tissue. The crest of the alveolar bone is being resorbed owing to the inflammation produced by the irritation of the ligature.

There was no soreness nor loosening of any of the human teeth shown, and from clinical findings we would expect a minimum of damage.

COMMENT

From these experiments, it is evident that the much feared injuries supposed to be caused by orthodontic appliances are more theoretical than real. We see that a necrotic area of the peridental membrane will heal, that a resorbed area of the tooth will be repaired by secondary cementum, that an irritated gum will heal. All of these phenomena are due to Nature's kindness.

However, the bounds of safety can be overstepped. To prevent this, orthodontic knowledge and judgment must be used. The successful orthodontist has, by intelligent observation, come to recognize certain clinical signs which tell him just when he is about to overtax the healing tolerance of Nature. Better results can be obtained by analyzing the forces used and giving the supporting tissues sufficient time to react to the forces, before the appliance is readjusted. It is evident, from the material presented, that the rapid movement of teeth with auxiliary springs which are active through a space greater than the width of the peridental membrane, and when the tooth is in occlusion, causes multiple root resorption. This is in accord with Oppenheim's findings.[1] These areas of resorption will disappear, provided sufficient time elapses between adjustments and the supporting tissues are allowed to return to normal. The same movements can be produced by more rigid appliances with far fewer instances of resorption.

From this material, it is evident that the amount of space through which the force is active, and not the degree of

orthodontic force used, is the important factor. The time elapsing between adjustments and the forces which act on the tooth other than the orthodontic force (such as the forces brought to bear on the moving teeth during mastication) are also important.

It is admitted that there are great individual differences in patients. Some respond to orthodontic treatment much more rapidly than others; and it is here that orthodontic experience and judgment are important. One gains this experience only by accurate case analysis over a long period of time.

There was root resorption in all cases in which the force was active through a greater space than the width of the peridental membrane and the tooth occluded with the teeth in the opposing arch. This occurred even though the force was as small as 0.5 gm. A. M. Schwartz states, in his formula of degrees of biologic force, that a force of 20 gm. per square centimeter of root surface will produce biologic tooth movement.[2] He proves this statement by moving the premolars of dogs and showing that forces of 20 gm. or less produce a biologic tooth movement. However, the premolar teeth of dogs do not occlude when the jaws are closed; and also the mandible does not have the same movements as those of the human mandible. Therefore, these findings cannot be applied to man. In Figures 7 and 8, a 100-gm. force was used, and the tooth moved biologically. It did not occlude with teeth in the lower arch; whereas, in Figure 5, the tooth was moved with a force of only 5 gm. and there was root resorption. This tooth occluded with teeth in the opposing arch. In Figure 10, the tooth was moved with a force of 150 to 200 gm., active through 0.15 to 0.2 mm. The tooth moved biologically. This tooth was in occlusion. In Figure 9, the tooth was moved with a force of 120 to 150 gm., active through 0.2 to 0.3 mm. There was root resorption in this tooth, which occluded with the teeth in the lower arch. These four cases show that it is not so much the amount of force that produces root resorption as it is the distance that the force is active. One could use a ton of force if it were possible, and as long as the force was not active for a great enough distance to obliterate the blood vessels in the peridental membrane in any area, the tooth would probably move without root resorption.

It is granted that if one could apply a force light enough to be under the blood pressure in the pressure area of the peridental membrane, it would probably be possible to move the teeth without resorption, even though the force were active for a distance greater than the width of the peridental membrane space.

Alexander Klein measured the peridental membrane space of a large number of teeth and found the average width to be 0.23 mm.[3] Since the alveolus has the shape of an hour-glass, the peridental membrane space is widest at the crest and narrowest near the middle, then wider again in the apical region. Therefore, the heavy force must be kept active through less than 0.2 mm. when the teeth are in occlusion.

In certain cases of idiopathic root resorption, progressive resorption of the roots occurs without orthodontic force.[4]

CONCLUSIONS

1. Root resorption occurs in practically all cases of malocclusion that are treated orthodontically.

2. Necrotic areas are produced in the peridental membrane in a large percentage of cases of malocclusion that are treated orthodontically.

3. The necrotic peridental membrane and the resorbed areas of the root will

undergo repair provided the force is not reactivated too often.

4. It is possible to move a tooth buccally or labially so rapidly that the buccal or labial process will be obliterated.

5. Auxiliary springs permit "jiggling" of the teeth that are in occlusion, often causing root resorption.

6. As fixed appliances do not permit jiggling, less root resorption is caused by the use of fixed appliances.

7. Relatively few pulps are killed by orthodontic forces.

8. The injuries to the gingivae can be reduced by the use of well-fitting appliances.

9. Enough time should elapse between adjustments to allow all the supporting tissue to return to normal.

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SOME FEATURES OF THE MANDIBULAR ARTICULATION AS IT PERTAINS TO MEDICAL DIAGNOSIS, ESPECIALLY IN OTOLARYNGOLOGY

By JAMES B. COSTEN, M.D., St. Louis, Mo.

WHEN, in the course of study of cases with neuralgia and ear symptoms, which otherwise might have fitted into ordinary groups in medical diagnosis, it was noted that these conditions improved after repositioning of the jaws, study of the anatomy of the temporomandibular joint seemed necessary for their explanation. Simple overclosure was obviously associated with the cases of deafness, and irregular movement of the condyles with the jaws in faulty rest position was identified with the irritative and neuralgic types.

(From the Department of Otolaryngology, Washington University School of Medicine, and the Oscar Johnson Institute.)

(Read before the Section on Partial Dentures—Crown and Bridge at the Seventy-Third Annual Midwinter Clinic of the Chicago Dental Society, February 17, 1937.)

Grouping of these symptoms into a well-defined class constantly associated with mandibular joint dysfunction required not only adequate anatomic explanation, but also clinical proof, by relief of a large number of cases through repositioning of the jaws and condyles according to accepted principles of prosthetic dentistry.

Prolific reference has been made in the dental literature to this relationship by Monson,[1] Wright,[2] Decker[3] and others, and later by Goodfriend,[5] who ascribed notable deafness in these patients to compression of the external canals of the ears to a point of closure by the condyles and also to trauma of the tympanic plate by the condyles causing concussion of the internal ear structures. Smith,[4] whose excellent report was unfortunately over-

looked in my review of the dental literature, referred to the need of constant patency of the eustachian tube and suggested that the closed-bite caused deafness by forcing back the tongue to displace the soft palate backward and upward, and placing great pressure on the pharyngeal opening of the eustachian tube, which lessens patency of the cartilaginous portion of the tube itself and causes atrophy of the palatine muscles, through which the patency of the lumen of the tube is controlled. Goodfriend,[6] pointing to reflex effects from trauma of the auriculotemporal nerve on the structures of the tympanic cavity, considers these factors more logical. He states: "The inflammation of trauma is a predisposing cause of the symptoms associated with the eustachian tubes, viz., head noises and tinnitus, while the exciting causes are infectious involvements from the nose and throat." Harris,[7] in describing the applied anatomy of the mandibular joint, mentioned the proximity of the auriculotemporal nerve, and its frequent injury from loose movement of the condyle resulting "in severe reflex pain, which is immediately relieved by advancing the mandible . . ."

Regarding reflex pain and irritative effects on the nerves in close proximity to the moving condyles, we find early recognition of the influence of the chorda tympani and auriculotemporal nerves in relation to salivary secretion in the experimental physiology of Czermak (1857), Heidenhain (1878) and Smirnow[8] (1893), who observed increased or diminished production of saliva with varying degrees of stimulation of these nerves. Sharp and lancinating pains within the palate and tongue were described by Butlin[9] in 1885, in a patient suffering from articular rheumatism at the time of the affection of the tongue, and in whom the temporomaxillary articulation was attacked two days before the tongue. Brown,[10] referring to abnormal function of the temporomaxillary articulation as a source of pain, states (1912) that there are many cases on record in which trigeminal neuralgia has been relieved by the insertion of suitable plates to hold edentulous jaws sufficiently apart to keep the condyloid and coronoid processes of the lower jaw in right relation to the surrounding parts. Almost all writers, in describing functions of the mandibular joint deranged by malocclusion, have referred to reflex pain about the joint and head.

In attempting to establish a symptom complex which could be regarded as typical of deranged function of the mandibular joint, various difficulties were encountered: Cases presented only a part of the symptoms; cases showed various sinus, ophthalmic and constitutional findings in addition to exactly similar effects arising from the joint disturbance; simple measures to hold the jaws apart, a treatment denture, or a roentgen-ray study showed paradoxical results; tests on ear patients showed eighth nerve as well as catarrhal deafness, the origin of one or the other not being given in the history. Further, neurotic or very ignorant patients described misleading reactions. However, long before the present series of 165 patients were observed, a group of symptoms were identified[11] as occurring uniformly in disturbed function of the temporomandibular joint.

The ear symptoms were: intermittent or continuously impaired hearing; stopping of, or "stuffy" sensation in, the ears, marked about meal time; tinnitus, usually "a low buzz," and, less often, a snapping noise while chewing; dull or "drawing" pain within the ears, and dizziness, with nystagmus.

The pain and irritative symptoms were: headache about the vertex and oc-

ciput and behind the ears, a typical site of posterior sinus pain, increasing toward the end of the day (atypical sinus history) and suggestive of eye headache; burning sensation in the throat, tongue and side of the nose; dryness of the mouth with almost total absence of saliva; occasional herpes of the external ear canal and buccal mucosa, most marked on the edentulous side.

Ear cases were represented by a group of fifty-two, in which fork tests showed varying grades of catarrhal deafness. Many of these also showed headache in addition to deafness, tinnitus or dizziness. The disappearance of dizziness on inflation of the eustachian tubes was considered important in diagnosis of overclosure and compression of the tube. In all cases except those in which the catarrhal deafness was due to chronic nasal infection or those having a coincident nerve deafness, the hearing improved at once after inflation. As it seemed difficult to reconcile this prompt change with the previous theories as to concussion of the internal ear structures, which would require months for recovery, anatomic study was made by serial sections through the joint and ear structures. A plane was found in which, when the jaw of the soft tissue specimen was overclosed manually (to imitate similar overclosure in life), all soft tissues next to the eustachian tube, including the tensor veli palatini muscle, bordering the membranous anterior edge of the tube, and the adjacent sphenomeniscus muscle, were seen to wrinkle and close the tube firmly. This coincided with the fundamental studies of Prentiss,[12] who demonstrated relaxation of the sphenomandibular ligament when the mandible is closed and the fact that the ligament is a part of the general fascia which encloses the external and internal pterygoid muscles. These functions explain the improvement in condition of the eustachian tubes when the bite is opened, whether the ears are treated or not; account for the habit of the deafened person of dropping the mouth open when intently listening, and explain the comfort afforded the miner when he opens the eustachian tubes just before the concussion of a blast by opening his mouth—all dependent on tensing the sphenomandibular ligament.

The symptom of tinnitus was accounted for by the buzzing sensation which occurs in typical catarrhal deafness, and the less frequent snapping noise was attributed to perforations of the meniscus of the joint, as originally described by Prentiss.

Dizziness which could be relieved by inflation of the eustachian tubes, and therefore distinguished from that of toxic labyrinthitis, was found in fourteen of the fifty-two ear cases.

Ninety-four patients, representing the commonest type of case in the series, complained of head pain. Almost all localized the pain as vertex, occipital and about the ears, eighteen emphasizing supra-orbital distribution. If we disregard posterior sinus or eye disease, of which these were typical, but which were ruled out by absence of findings, anatomic reasons could be found within the pathologic mandibular joint:

1. Irritation of the auriculotemporal nerve by the unsupported movement of the condyle, mesially or backward, as the nerve passes close to the mesial side of the joint capsule, between the condyle and the tympanic plate to distribution over the vertex and temporal region.

2. Production of reflex pain and sensory disturbance in the various connections of the chorda tympani nerve, the condyle irritating it where it emerges from the tympanic plate via the glaserian fissure, at the mesial edge of the glenoid fossa.

3. Perforation of the articular disk

and impaction of the thin bone of the glenoid fossa, permitting close contact of the condyle with the dura, as clearly shown by specimens in the collection of Prentiss,[13] and similar ones in our anatomic specimens.

The first and most obvious sign in this class of cases was the wide, sudden shifting of the condyles at some point during the slow closure of the mouth, the movement being clear enough to be observed within the soft tissues of the back of the throat. One or both joints were tender to internal palpation; and there was absence of molars on the side of greater pain or malocclusion of the natural teeth, producing a similar absence of molar support. Roentgen-ray study revealed destructive changes in the joint. Further, diagnosis was confirmed by extending the affected side by placing an arbitrary number of 2 mm. cork disks within the jaws. Even if nothing is shown by this simple test when the first mentioned signs are present, the patient is urged to proceed with repositioning of the mandible in the proper manner. This test is valuable if positive, and at no time have I advocated it as a method of treatment, or as a measure of the amount of change necessary to the case. It has been used to illustrate the anatomic points involved, and the figures given in my reports were those estimated by the prosthetic dentist after completion of whatever reconstructive measures were used.

Perhaps the most valuable of all the results obtained by these observations has been the collection of evidence that irritation of the auriculotemporal nerve by impaction of the condyle is the chief etiologic factor in glossodynia, or burning tongue. In the thirty-three cases examined to date, local lesions about the tongue were absent. Cases showing salivary disturbance, dry mouth or excessive saliva, nine in number, are confined entirely to this class. All except four were entirely relieved by repositioning of the jaw.

The etiology of burning tongue has been conceded to be unknown by all medical writers, early and late. Butlin,[9] in 1885, stated that it was apt to be aggravated by every movement of the tongue, whether in eating or in speaking. Blair,[14] in 1912, said that painful affections of the tongue in the area supplied by the lingual nerve may be accompanied by severe neuralgia deep in the meatus of the ear. Oppenheim,[15] in considering it neurologically, stated that it is not on the whole a very common symptom, and generally affects women of advanced age and that the teeth are almost always absent. All described its distribution completely, and recommended psychotherapy, reassuring the patient against the fear of cancer.

The results of treatment of this group clearly indicate that glossodynia without local lesions of the tongue is most often a painful effect produced in the lingual nerve supplying the anterior two-thirds of the tongue, by reflex irritation of the auriculotemporal nerve within the mandibular joint.

The roentgen-ray studies of part of the series were made in the Mallinkrodt Institute of Radiology, under the direction of Drs. Moore and Scott; the remainder, in the laboratory of Dr. E. C. Ernst. The exposures were made in the Sproull position, and various changes from normal were noted: (1) fibrosis of the joint capsule; (2) erosion and flattening of the anterior and superior face of the condyle, and to less extent of the articular eminence, and (3) wide excursion of the condyle forward in greatly loosened joints.

Precision roentgen-ray studies, such as are described by Gillis,[16] Lindblom,[17] Higley[18] and others as controls during treatment, were not used.

SUMMARY

A symptom-complex of neuralgia and deafness associated with malfunction of the temporomandibular joint is defined by clinical, anatomic and roentgen-ray study. It is further confirmed by the relief of most of 165 cases after proper dental reconstruction, to reestablish normal relationship of the condyles within the glenoid fossa.

The neuralgia and deafness correspond exactly with certain effects of sinus, eye and ear disease, and must be differentiated. In general, the ear symptoms predominate in edentulous mouths as a pressure effect producing catarrhal deafness. Cases with pain effects fall into the class with loss of molar support on one side only, or with malocclusion sufficient to produce destruction of one or both temporomandibular joints.

Failure to relieve pain symptoms has been most consistent when, in the effort to "open the bite," the condyle was brought to rest upon the articular eminence, impinging on the part of both bony structures where erosion most often occurs.

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Beaumont Medical Building.

PRESIDENT'S ADDRESS

By LEROY M. S. MINER, M.D., D.M.D., Sc.D., Boston, Mass.

MAN is a social being. The union of men with common interests, whether religious, social, industrial or professional, has always been a natural tendency and is but a manifestation of the associative spirit which is inherent in mankind. The craft guilds which flourished in the thirteenth, fourteenth and fifteenth centuries and which were primarily concerned with the problems of their particular occupation or craft were, in some respects, similar to the various professional organizations of our day. They did, however, control the monopoly of working and dealing in a particular branch of industry. Trade secrets were zealously guarded; craft welfare became an absorbing passion. Intent only on promoting their own interests and disregarding the welfare of the community as a whole, the holders of such trade secrets quite naturally and properly fell into disrepute and gradually disappeared.

This carries a lesson not only for our professional societies, both state and national, but also for the present-day trade union as well. *Any organization primarily devoted to the selfish interests of its members and which disregards the welfare of all the people cannot and should not endure.*

No man can serve as President of the American Dental Association and not be impressed with the unselfish devotion of hundreds of its members to the highest professional ideals. Throughout the country, men and women of the dental profession are working quietly but effectively to make the service of the dentist constantly more useful to our people.

There is being woven into the fabric of dentistry a pattern in which public service is predominantly outlined. The threads which form this pattern are many, but one of particular significance is that of Public Health. *Today, the health of the public is as much the concern of the dentist as it is the concern of the physician.*

Dental Health Education is another thread which is interwoven with that of Public Health, and the two support each other and cannot be separated without weakening the whole fabric.

The thread of Preventive Dentistry also gives support and must run through the whole pattern. Its importance is suggested by the fact that we have as the chief theme of this Annual Session "Preventive Dentistry in the Interests of Health."

The work done by the American Dental Association in the weaving of this new fabric of dentistry very properly looms large, for our Association includes all branches of the profession, and its activities are wide-spread.

To give succeeding presidents the opportunity to discuss significant aspects of this work is presumably the reason for this annual address, and so I follow the example of my predecessors by discussing some of the activities of my year as President. The time limits of such an address naturally preclude discussion of all ac-

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tivities, and so I have selected some of those around which active discussion has especially centered this year.

PUBLIC HEALTH

I have already made the statement that today the health of the public is as much the concern of the dentist as it is the concern of the physician. May I commend for your attention the published report of our Public Health Committee, of which Dr. James F. Owens is Chairman. Every member of this Association should read it, especially the officers of our state societies including the members of the legislative committees, for it is a significant document. If dentistry is to fulfil its obligations to the public, the plan to expand dental public health activities in our various states should be cordially supported.

The Committee makes eleven recommendations, all of them sound and sensible. The first four deserve especial emphasis. They are as follows:

1. That some as nearly as possible uniform dental health organization be formed within the state board of health in each and every state.
2. That the dental organization in each and every state board of health be a separate division or bureau, not secondary to any other division or bureau.
3. That dental personnel of a state health department be trained in public health, such training to conform in a general way to meet requirements for a medical personnel and the qualification standards set up in this report.
4. That dental schools accept responsibility for organizing a course for dental health personnel, and that such course, or courses, be established in conjunction with already established public health schools.

The great impetus to dental public health aroused by the the inspired work of the late Dr. C. T. Messner stands as a memorial to his foresight. His statement "Unless the organized dental profession takes definite leadership in developing a plan of dental health activities and urging that dentists be trained in public health training centers, I firmly believe it will lose the golden opportunity provided for in social security legislation" deserves our thoughtful consideration. The interest taken in this movement by the United States Public Health Service continues. Dr. Parran's support is assured. Dr. Frank C. Cady, dental surgeon, United States Public Health Service, is continuing the fine work of Dr. Messner.

Partly as a result of this interest and support and partly as a result of the report and recommendations of our Public Health Committee, one university is offering this fall a year's course of training in dental public health under the combined auspices of the school of public health and the dental school. Other universities will organize similar courses and we shall soon see the development of a new educational activity in the dental profession.

DENTAL EDUCATION

Education is one of the important factors in the vitality of a profession and provides for its growth and development. It is encouraging for the future to see members of the profession at large becoming interested in this vital subject. Education in any field cannot be static. It is subject to constant change and revision. Today, there are active ferments in dental education. Figuratively, we think of a ferment as a condition producing a state of commotion or agitation and even excitement. Such a situation has frequently beset the dental profession, eventually bringing about changes for the most part that have been progressive and beneficial. Literally, we think of a ferment as a chemical substance capable of producing reactions and bringing about new sub-

stances. Applied externally, a ferment may act as a stimulant and an antiseptic. As a poultice, it may correct the discharge of indolent ulcers, and, when given internally, it frequently invigorates and refreshens. Ferments, like yeast, we have found, clear up humors and depressed states of vitality, and we have lately learned that the yeast ferment contains certain vitamins which provide real nourishment. Ferments of this kind have also been working in the dental profession. They have helped to raise its depressed states, and have nourished it and brought it to a better state of health. The ferment that worked for many years within dentistry, and for its good, might be called a mechanical ferment, in which the agitation and excitement were concerned chiefly with the development of better skill and better technics. So effective was this ferment that, from a technico-logical point of view, American dentistry set the standard for the world.

Since the study of dental education by the Carnegie Foundation, there has developed an intellectual ferment, and this can actually be said to have made things boil. It seems significant that the agitation in dental education has not been confined to members of the faculties of our dental schools or to the boards of examiners, but has extended to the profession itself.

Another active ferment now is the Dental Educational Council of America. Even the most bitter critics of this independent organization (independent although it draws its support from the American Dental Association and its membership jointly from that body, the American Association of Dental Schools and the National Association of Dental Examiners), which celebrated its twenty-fifth anniversary two years ago, will admit that much constructive work has been done by this body, which has advanced the cause of dentistry. It has been charged that some of its acts have suggested insincerity and political intrigue, resulting in a definite loss of prestige.

At the Annual Session of the American Dental Association in New Orleans in November 1935, active discussion took place, the outcome of which was a vote of the House of Delegates authorizing a committee to make a study of how the American Dental Association might serve better the cause of dental education. With the short time at its disposal and with little or no funds, the Committee did function and presented its report at the meeting in San Francisco. The principal study was the Educational Council. Recommendations involving minor changes in the setup of the Council and a program suggestive of the aims and purposes of the revised Council were adopted by the House of Delegates at San Francisco, and the Board of Trustees was authorized to set up this Council. It seemed futile, however, to proceed without the full cooperation of the American Association of Dental Schools and the National Association of Dental Examiners, and so a committee from the Board of Trustees was appointed to confer with similar committees from the other two organizations.

The most important recommendation adopted by the House of Delegates, however, was to provide a full-time secretary of the Council with an office at the headquarters of the American Dental Association in Chicago. If funds can be found and the right type of man be obtained, a ferment which has been rather bitter may change to one which will nourish and bring strength to dental education.

Tolerance, straight thinking, intellectual honesty and unselfishness must all enter into this educational reaction if the House of Delegates is to succeed in settling the matter wisely and well.

I have suggested that these ferments are in large part wholesome, and that they

do clear up humors and depressed states of vitality and provide real nourishment. They should be encouraged. Agitation has to precede clarification. We should share Keats' optimism suggested by the line "Yeasting youth will clear itself and crystal turn again."

PROFESSIONAL JOURNALISM

The literature of a profession furnishes both light and power to that profession, so everything possible should be done to increase the quality of our literature. THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION is the chief measure by which the results of research, both laboratory and clinical, may be brought to the attention of our members. We should be jealous of the integrity of that journal. By vote of the House of Delegates in San Francisco, the Board of Trustees was authorized to accept the gift of the *Dental Cosmos,* a journal which served effectively the dental profession in the days when dentistry did not have the means to develop its own literature. Under this authority, a committee from the Board of Trustees proceeded to make arrangements for receiving this gift.

It is unfortunate that rumors are being spread that are entirely without foundation, in fact, are working a rank injustice to the donors and suggest a lack of integrity on the part of the Board of Trustees. The details come before the House of Delegates for final approval. Our judgments should be mature and tolerant.

RESEARCH

The advances made by a profession like dentistry founded on the biological and physical sciences are in direct proportion to the soundness and effectiveness of its research program.

The members of the American Dental Association should become more thoroughly familiar with the fine work being done at the Bureau of Standards in Washington under the supervision of Dr. Wilmer Souder, through a grant made by the Research Commission. This study of materials used in dentistry and the establishment of standards is of practical benefit to every practicing dentist, for it helps to insure the uniform quality of his work. The members of this research group deserve the highest praise for their thoroughly scientific contributions to dentistry.

The grant made by the Research Commission to the *Journal of Dental Research* was especially timely and thoroughly deserved. The *Journal of Dental Research* does much credit to dentistry through the dignity of its editorial policy and its high quality as a professional journal. It should receive more substantial support by the American Dental Association as an organization and by its members individually through annual subscriptions to the *Journal.*

Of special interest is the ambition of the Research Commission to establish fellowships for the study of dental caries, to work with the United States Public Health Service or some other established research group.

And I could go on to elaborate on the excellent work being done by the other councils and committees whose work is contributing so much to sound progress. A careful reading of the reports of the officers and committees will suggest how great an organization is the American Dental Association.

But we must not relax our efforts to go forward. There are many problems of major importance before us. The times are calling for the best that is in us. An old civilization is in the discard. A new socially conscious age is in the making. Men and women who never before had a chance are going to have it now. Over great areas of the earth's surface, life has

changed more radically during the last twenty-five years than it has before in six thousand years. The technician and the scientist have done their part to improve conditions of life. The failure to translate these technical and scientific values into human values is at the bottom of much of our trouble and unrest. In other words, our spiritual progress as a nation has failed to keep pace with our material progress. For this reason, the revolutionary age in which we now live cries out for leaders. Men and women with trained minds and skilled hands, with the ideal of service to humanity constantly before them, will help the world to advance morally and physically and to lead what Professor James called "significant lives in which the strands of friendship, leadership, workmanship and service are closely interwoven."

As professional men and women, we should have constantly in mind that the fire of honor and integrity and zeal for service must be kept burning ever brightly within us, and that dentistry must be a profession of aspiration, determined to realize the full possibilities of that ancient truth that the health of the people is the supreme law.

THE PROBLEMS OF THE EDITOR

By C. N. JOHNSON, M.A., D.D.S., L.D.S., Chicago, Ill.

TO enumerate all of the problems presented to the editor would manifestly be impossible in the limits of a single address. At every turn of an editor's life, as you who are editors know only too well, certain emergencies arise which tax the ingenuity, judgment and patience in a way that no one realizes except those who have had experience as editors.

It is, of course, not to be expected that all of the ramifications of an editor's life shall be considered in a brief presentation of this character. We shall do well if here and there in the vast field of this subject, we are able to make a few suggestions that may aid in smoothing the way for our fellow editors in the myriad complications that beset an editor in his daily problem.

The thing most vividly in mind at the present moment is the possibility of aiding some of our younger editors and pointing the way to an easier and more effective fulfilment of their allotted task. About the first thing an editor learns is that his life is filled with perplexities, and the next thing he learns is that it is filled with more of them. But these perplexities become the very spice of life to an editor as he learns to meet them in a cheerful spirit, and accepts them as merely the routine incidents of daily life.

Sometimes it would seem that an editor is subjected to a greater amount of worry than falls to the lot of most men. Probably if an analysis were made, it would be found that there is a greater opportunity for mistakes in editorial work than in any other. In any event, there is no question that mistakes when once made are more conspicuous and glaring than in any other activity of life. With this statement, there is little question that most edi-

(President's address read at a meeting of the American Association of Dental Editors, Atlantic City, N. J., July 10, 1937.)

tors would agree. Yet this editorial game is not all one sided, and if it is true that we apparently have more than our legitimate share of grief, it is also true that we have our full measure of compensation. Otherwise we should not find so many men willing and even eager to accept editorial responsibility.

No attempt will be made in this presentation to consider in detail or even to enumerate all of the problems encountered by an editor. We shall do well if we succeed in calling attention to certain of the more pressing problems as they occur in the daily life of the editor, and make a few suggestions as to possible methods of solving them.

Probably one of the most persistent and baffling problems that confront the average editor relates to the necessity for the rejection of manuscript that has been submitted for publication. It is perhaps common knowledge that not one-half of the material submitted to an editor for publication is found available. This may be for various reasons, one at least of which is lack of space. But no matter what the cause, the return of a manuscript always presents an embarrassment to the editor. At once, he is charged with favoritism or something worse, and his judgment is assailed or his motives impugned. It is doubtful that any contributor to any magazine ever accepted a rejection very graciously. Yet, as a matter of actual fact, it is often more painful for an editor to reject a manuscript than it is for him to accept it. It is probably true that many an indifferent manuscript has been inflicted on the reader through mistaken sympathy on the part of the editor. Yet these men are accounted hardboiled and inconsiderate. If the readers only knew!

This matter of manuscripts is really one of the bugbears of an editor's life. It is a constant Scylla and Charybdis. The editor must constantly sail between the necessity of refusing much material with all of the consequent embarrassment, or of accepting a great deal of material that can be of benefit to no one. And the wonder is that more rocks are not encountered than there are. After all, the acceptance or rejection of manuscript is a very intricate game, and some of the very best editors in the world have made mistakes of judgment in deciding on the merits or demerits of submitted material. It is a noted fact that masterpieces have on occasion been refused, at the same time that the most indifferent material has been accepted with open arms. Of course, we all know that there is a reason for this; in fact, there are sometimes many reasons. This whole question of judging manuscript is worthy of an entire paper even in a subject as limited in extent as that of dentistry, and sometime our association must have such a paper. Suffice it to say at this time that with the amount of waste material in the ranks of our periodical literature, we shall do well to draw the lines of acceptance a trifle more rigidly than we have been doing in the past. Yet the very moment that this is uttered, there is a consciousness that the tangible results of such a statement will be very meager as far as practical results are concerned. In other words, the probabilities are that in the future the percentages of rejection will run along about the same as in the past. This statement is made on the basis of a somewhat extended experience in handling manuscript, and in view of a certain knowledge of human nature. But this much may be said: a better understanding is constantly being manifest on the part of contributors and editors, and the machinery of editorial work consequently runs more smoothly and harmoniously than it formerly did. Mayhap the reason for this is found in a clearer conception of the problems involved on

either side, and in a larger tolerance of the opinions of others.

One of the great attractions of editorial work is the sense that an editor has of being a medium through which public or professional opinion is molded. No influence that an editor exerts is ever quite comparable to the feeling of power that he possesses in directing the thought of the profession or the public. Probably one of the greatest sources of his inspiration in putting energy into his work is derived from the fact that through this medium he may influence for good the lives of his constituents and create a better order of things within the range of his influence. When an editor realizes that the things he admits to the printed page may help to determine human destiny, he at once begins to look on his task with a greater sense of its seriousness, and the zest that he experiences in his work is in large measure made up of the realization that what he is doing is of prime importance in the ultimate scheme of life. The longer an editor studies his work, and the more he observes of its potentialities for good or ill, the greater becomes the sense of his responsibilities, and unless an editor becomes more and more alert as to his obligations in the case, he is not the right kind of editor.

In a certain sense, the very thing that involves the greatest hardship on an editor is frequently the one that brings the surest sense of satisfaction and achievement, and unless a man elects to play the game of life in its fullest functioning, he would better not decide to be an editor at all. It has sometimes been remarked that a poor dentist is among the poorest of all human incompetents, but if the matter were submitted to an impartial test, it is likely that the palm would have to be yielded to the incompetent editor. After all, merit counts whether in an editor, a bricklayer or a digger of ditches.

It might seem appropriate to discuss in brief certain of the rewards and penalties of editorial work. One of the major rewards is the one just indicated, the possibility of influencing for their welfare the lives of one's fellowmen. No sense of satisfaction is ever quite equal to that of the feeling that through the medium of one man's mentality, another has been able to work on the mentality of others to their betterment. If there is a glow of enthusiasm in doing good in the world, the influence of the printed page cannot be ignored as a means of mental uplift, and the editor is the one to experience this each day of his life.

Down deep in every man is the love of power. It may be the laudable ambition to do good in the world, and sometimes it seems to be the unholy ambition to acquire the power to oppress others. It is probably true that there is no other medium of exerting power equal to that of the printed page manipulated by an able editor, and thus the function of the editor becomes a really tangible and serious obligation. The more one studies the prerogatives of an editor, the more impressed one becomes with the seriousness of his responsibility. It is not only what he says in his editorial page, but also what he permits others to say in the body of his magazine that must be carefully considered in its influence on the welfare of his constituents. Editing any publication, even one with the relatively limited circulation of a professional journal, is sure to involve a really unique responsibility, and doubtless the members of our own organization have long since realized this fact. In passing, it may be stated without equivocation that the work being done by our own body of dental editors is more and more to be commended. As an important contribution to the literary output of the profession, dental editors are making a most laudable effort to main-

tain the best traditions of our craft, and this is particularly true of the growing body of younger men who are continually being pressed into service. It may confidently be predicted that, as the years go on, our profession shall have reason to be more and more proud of its periodical literature.

This does not imply that everything is completely rosy in the field of dental journalism. We have many hurdles yet to face, and if, in the days to come, we occasionally encounter the obstacles that are naturally inherent in this line of effort, we must not be too disappointed.

One of our minor handicaps relates to the activities of certain of our perpetual critics. It is probably true that if we did not have critics, we would be in danger of developing a certain amount of "smugitis," and this is considered in some quarters to be fatal to both safety and sanity. We need critics, of course we do. They are essential to our mental balance; but we do not need critics as much as we need the effect of the spontaneity and enthusiasm of young men and women who are bursting with energy and initiative that seeks expression at all hazards.

It has frequently been said that a critic seldom was known to create anything worth while. The truth of this contention is apparent everywhere, and we can assuredly do without our critics better than we can do without our creators. If there is a spectacle in life that is sad and unfortunate, it is the critic who is constantly picking flaws and pointing out the limitations of others. The wonder is if this kind of person ever accomplishes anything worth while or ever succeeds in getting any happiness out of life.

Blessed be the critic who, in the fulness of his heart, honestly seeks to right a wrong or remedy a defect, and does it without an ulterior motive. We hear much in these latter days of so-called "constructive criticism," and we are forced to honor the intent of the man who seeks whole-heartedly to make the world better. But if we pursue the motives of most critics, we shall find that ultimately the object of their criticism is found to be not so much to remedy a fault as to uncover a flaw.

While nothing in this presentation may be considered to have specific reference to any set of circumstances or to any particular contention, it may be salutary to call attention briefly to a certain line of criticism that has for its motive the best possible intent and the most laudable effort at reform. In the published proceedings of our own association, on page 58, will be found a most praiseworthy attempt to point out what the author honestly believed was a necessary reform. To make the critic's point of view seem quite valid, and to afford him the widest possible range of representation, a very liberal quotation is herewith made from his remarks. He says:

> Last but not least of any volume is its index. It is the last thing to be prepared and the first one to be consulted on opening a book. Let us realize for a moment what an index to a volume really means. Without it one would have to turn all its pages to find the desired information; without it our libraries would be an accumulation of books to which the keys are lost. Anyone familiar with literary search will have found that the indexes to dental periodicals differ greatly in their quality and usefulness. With the exception of the indexes to the *Dental Cosmos* and the *Journal of Dental Research,* there is no other acceptable and useful index to dental periodicals. Thus the index to *The Journal of the American Dental Association* is split up into fourteen different sections: Frontispieces, Original Communications, Editorial Department, Annual Meetings, Obituaries, Practice in Paragraphs, Council on Dental Therapeutics, Bureau of Public Relations, Dental Economics, Cur-

rent Literature, News, Miscellany, Library Bureau and Contributors. To find any particular subject it becomes necessary to hunt among these 14 sections, whereas *one* or at the most *two* sections, alphabetically arranged, are sufficient. In the dictionary style of index both authors and subjects are in one alphabetical list, while a separate listing of authors and subjects is also common. The most important and influential dental periodical today is handicapped by such an obsolete form of index and its annual 2,200 pages are made greatly inaccessible for quick reference work.

In all conscience, this would seem to be quite a liberal arraignment, and all set forth with honesty of purpose and an undoubted attempt to be helpful and constructive. If all of our critics were equally frank and generous, there would be little complaint to be made of them.

But permit us to discuss the practicalities of the situation in this instance for a moment. The journals endorsed by our critic are in a different class from THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION, wherein the items to be indexed are so much more numerous that there is no comparison. To follow out the plan indicated by our critic would involve the printing each month of at least four full pages of index. At the end of the year, this would mean at least forty-eight pages. It is conceivable that our readers might question this, in view of the fact that many of them are practical men and not greatly intrigued with too much technical detail. Doubtless the plan of our critic might appeal to a certain few of the readers, but the rank and file that constitute the main body of the membership of the A.D.A. might reasonably be expected to raise a few eyebrows if the plan were put in operation. The experiment would be rather formidable unless we were perfectly certain that it would prove successful and practicable; but at least it should be said that the plan suggested is worthy of further study and the most careful deliberation, and some day an attempt may be made to put it in operation.

After all, the thing we most need in editorial work is breadth of vision and tolerance for the opinions of others. If any man should be broadminded, an editor should. If any man needs charity in his heart, an editor does. He touches human life at its most vital and its most intimate points. He feels the pulse of humanity in its varying moods and manifestations, and he learns to play on the intellect as well as on the emotions. He must be all things to all men at the same time that he preserves the perfect independence of his own soul.

The editor is frequently blamed unworthily, but he must submit and smile. He seldom wins renown, and if he does the daws soon begin to peck at him and jibe. This he is supposed to accept and enjoy, even when the iron enters his soul. But with it all, we must claim for the editor's job a measure of reward greater than that of any other man in the ordinary walks of life. He has his grief, much of it, but compared with that of other men, he can rise superior to it with better grace and more abundant resilience than falls to the lot of most of his fellowmen.

Above all, an editor cannot but feel that he is a very essential cog in the great wheel of progress. In his daily endeavors, he may fall short of moving mountains, but at least if he is faithful to his trust, he may rest content in the assurance that he is contributing in a concrete way to the betterment of his fellowman. And if he succeeds in doing this, he is fulfilling a function the importance of which cannot be transcended in any of the ordinary affairs of life.

ALLERGIC MANIFESTATIONS IN THE ORAL MUCOSA

CLINICAL PICTURE AND DIFFERENTIAL DIAGNOSIS

By CLEVELAND J. WHITE, M.D., Chicago, Ill.

GREAT advances have been made in the last few years in the study of allergic conditions of the body, especially of the skin, *i.e.*, so-called eczema, and in the study of such conditions as hay-fever and asthma. The field of allergy has then become an important domain of internal medicine. The allergic phenomena can apparently be manifested in a great many different ways, involving various parts of the body. Interest in allergic conditions of the oral mucosa has been necessary on my own part in the past few years because they have been found very definitely in this area. The results of elimination of the allergic etiologic factors have been excellent. Twenty-two cases have been studied in the past three years in which the allergens were detected. Strange as it may seem, no mention is made of allergic manifestations in the oral mucosa, either on buccal surfaces or on the tongue, in any of five monographs on allergy by accepted American authorities.

Allergy may be defined as a state in which certain groups of cells or organs of the human body react in a specific manner when brought into contact with a substance which is foreign to the organ or the cells. One might say, then, that allergy is quite similar to modified sensitivity. For practical purposes, idiosyncrasy and anaphylaxis may be classified as identical to allergy. In a broad sense, allergic manifestations can be caused (1) by the ingestion of foods or medicaments (ingestants), (2) by breathing in certain materials (inhalants), and (3) by contact with extraneous substances (contactants). In a broad sense, the contactant causes what is oftentimes called a glossitis or, if on the skin, a dermatitis venenata. Stress will be laid on these three different factors or combination of factors, the details of detection, the clinical characteristics, the differential diagnosis and methods of desensitization, where such is possible.

As Prinz and Greenbaum point out in their monograph, allergy has been shown by both clinical and laboratory investigations to develop definite recurrent locations in circumscribed areas of the skin and, by analogy, of the mucocutaneous and mucous surfaces as well. In exceptional and rare cases, it is present in the entire cutaneous surface, as well as in the organs and tissues of the human body. Investigators have shown that there is a definite incubation, or latent, period varying in duration with both the individual and the precipitating agent. Although allergy is usually specific as regards the action of a particular drug, food or some other substance, one or more attacks from one particular substance may be followed by sensitization to several irritants, resulting in a case of multiple sensitization.

The clinical symptoms in these allergic manifestations in the mouth have ranged

(From the Department of Dermatology, Northwestern University Medical School.)

(Read before the Section on Medical Relations at the Seventy-Third Annual Midwinter Clinic of the Chicago Dental Society, February 17, 1937.)

from small papular and vesicular lesions to deep ulcerations, and in some patients to chronic thickening like a leukoplakia. The striking findings and complaint common to all is that of intermittent severity of the lesions, there being almost complete disappearance between attacks. The common finding is a symmetrical herpetic eruption. Investigation in every case was instituted first to detect whether there was any difference of potential in the dentures which might produce electrical currents and cause symptoms in that way. In only one of these cases could the lesions (large ulcerations in a patient of Dr. William B. Knox) be definitely traced to electrogalvanic currents produced by artificial dentures. In another, the gingivitis was definitely determined to be due to the mechanical phases of an ill-fitting denture. One patient was sensitive to the preparation used in the denture. The remaining cases were due to ingestants, with the exception of one, which was due to an inhalant and occurred during the pollen season. In practically every case, the patient had decided that the dental work was at fault, but this proved to be the fact in only a few instances. It is somewhat futile to discuss mechanical, physical and chemical insults to the mucous membranes of the mouth before a dental group who are instructed in and have studied these possibilities over a much longer period than physicians.

The work of Everett S. Lain on electrogalvanic lesions of the oral cavity produced by metallic dentures is well known to members of the dental profession. In a recent paper* on the electrogalvanic phenomena of the oral cavity caused by dissimilar metallic restorations, he states that the human saliva contains the necessary elements for a good electrolyte, whether its chemical reaction is neutral, acid or alkaline. Hence, a galvanic battery is constructed in every oral cavity where restorations have been made with two or more electropotentially dissimilar metals. The subjective symptoms are in most cases a burning or tingling sensation, usually occurring on the margin of the tongue. The objective findings are varied. There are usually erosions and ulcers on the dorsal areas of the tongue, and leukoplakia. All symptoms improve at once and all lesions, except leukoplakia, heal promptly after the removal of metals of either the positive or the negative group. After healing, homogeneous metals are used for replacements and this prevents recurrences. Lain uses a Weston micro-ammeter model No. 440 which has a range of 75 microamperes. Dental electrolysis can be avoided by testing mateials in buffered solution outside the mouth before casting in forms for restorations.

The diagnosis of allergic oral disturbances is made by their clinical periodicity, the recurrence of lesions on use of or contact with these agents and their disappearance on the elimination of the suspected articles. The subjective symptoms are burning, tingling and actual pain.

Food allergy was the most common finding, the most common causative foods in this series being chocolate, tomato, orange, egg, potato and milk. In most cases, sensitization was single and unaccompanied by allergic manifestations elsewhere in the body. While these foods were the most common, it is well known that patients may become sensitized to any food or condiment.

The detection of the causative foods is one of detailed study and observation. The best method is the use of elimination diets, which has been originated and promulgated by Rowe into a very practical method of study. A basic diet, such as is

*LAIN, E. S., and CAUGHRON, G. S.: "Electrogalvanic Phenomena of Oral Cavity Caused by Dissimilar Metallic Restorations." J.A.D.A., 23:1641, September 1936.

given here, is an abbreviation of Rowe's work. I use a basic nonallergic diet consisting of coffee, tea, carrots, lettuce, prunes, plums, apricots, lamb, veal, rye krisp, olive oil, plum jam and peppermint candy. It is used for a week. Then, if there are no new lesions, I begin to add one food a day, using at first the least allergic ones. If the offending food is added, new lesions will often appear in from four to eight hours. Obviously, that food is then eliminated, or desensitization may be attempted. I have not tried desensitization as most patients are willing to discontinue the food that causes trouble. The short cut, naturally, would be the use of the skin tests, by direct scratch, intradermal or passive transfer methods. Unfortunately, in several cases so tested by a competent allergist, nothing of importance was revealed. While the tests are very valuable in cutaneous eczematoid lesions, their value in the study of allergic conditions of the mouth is very limited. However, their use should not be discouraged, because at times, it is conceivable, a short cut may be achieved in this manner.

In lesions in which it is felt that there is a definite contactant, the patch test is of great value. This test is performed by application of the suspected irritant, in the same status or dilution, to the tender area of the forearm or back, covering the skin with sterile gauze and letting the application remain *in situ* for at least twenty-four hours. An erythematous or vesicular reaction at that site is considered positive. If a patient is supersensitive, the resulting reaction may be so pronounced that the irritant must be removed before the end of the twenty-four hours. In other patients, it is desirable to leave it in position for from forty-eight to seventy-two hours to be sure that there is no delayed reaction.

In food allergy, it is not always necessary to follow in detail any set of diets. Simply leaving out the most common offenders for a week and then leaving other foods out from time to time is effective. In a very sensitive patient, the clinical phenomena will appear in from two to four hours after ingestion. In others, the time will be from ten to twelve hours. In this same category, the ingestion of certain medicaments, such as phenolphthalein, iodides, bromides and luminal, may produce lesions of the mouth. The halogen group produces a red papular or pustular lesion, while the phenolphthalein lesions are violaceous circumscribed patches and, in some cases, of definite bulla formation. Luminal practically always causes a vesicular reaction, often associated with the same type of lesions on the body. Other drugs, such as arsenic and the phenobarbital group, occasionally do cause reactions in the oral mucosa.

As to differential diagnosis, the important lesions to rule out, of course, are the electrogalvanic phenomena. Others are erythema multiforme, leukoplakia, thrush, lichen planus, secondary syphilis, pemphigus, herpes simplex, lupus erythematosus and the blood dyscrasias. Erythema multiforme is a skin disease which produces annular bullous lesions on the back of the hands and on the lips. The eruption is seasonal and disappears very promptly on the administration of salicylates. Leukoplakia is characterized by hard whitish gray patches of irregular design and sometimes by hardened plaques. It usually occurs on the tongue, but occasionally on the buccal surfaces. Local irritation is the most common cause, but occasionally it has a syphilitic background. Antisyphilitic treatment has practically no effect on the lesions. Of course, it is a definitely precancerous condition, a precursor of the squamous-cell epithelioma, which metastasizes very rapidly to all parts of the body.

Thrush, or moniliasis, is characterized by white areas on the membranes, resembling coagulated milk. The deposit is easily removed by small forceps and *Monilia albicans* can be recognized under a 10 per cent potassium hydrate preparation. The fungi are also easily grown upon Sabouraud's medium and are easily recognized. While thrush is a fairly common condition in babies' mouths, it has been recognized as being fairly common in adults for only the past few years.

Lichen planus is becoming much more common in the mouth and is often mistaken for thrush or leukoplakia. It is manifested in five different ways; by (1) crossed white lines with internodal thickening; (2) annular white lesions; (3) definite papules; (4) large plaques with violaceous borders, and (5) rough wavy parallel white lines. It is often accompanied by violaceous papules, which appear on the glabrous skin. It in itself has never been known to become malignant.

Secondary syphilis is manifested by so-called mucous patches, which are evanescent areas of mucous appearance. These are extremely infectious and the cause of many extraneous infections, as by kissing. Of course, it is highly essential for the dental operator to recognize these to prevent infecting himself.

Pemphigus occurs in the mouth as recurrent bullae, which erode and are very slow in healing. The positive diagnosis is made by the phytotoxic test of Macht and the occurrence of lesions on other parts of the body. This disease is practically always fatal, even with the best of treatment.

The treatment of allergic conditions is primarily elimination of the positive agent. Active desensitization in food allergy is rather disappointing, but by abstinence from the food over a long period of time, an immunity can usually be established and in time the patient can have a full diet.

CONCLUSION

The clinical findings in allergic phenomena of the mucosa have been discussed. Detection of the allergen is emphasized. The differential diagnosis of the important lesions of the oral mucosa is delineated. Methods of treatment of allergic conditions of the mouth are discussed.

122 South Michigan Avenue.

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C. N. JOHNSON, Editor

L. PIERCE ANTHONY, Associate Editor

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*In deference to the wish of the dental profession to control its literature, *The Dental Cosmos*, founded in 1859, was transferred by the publishers as a gift to the American Dental Association, January 1937.

Editorial Department

THE INCENTIVE OF SEPTEMBER

FOR a few fortunate souls, the summer vacation extends into September, but for most of us the end of August marks the end of rest and recreation. The wise ones of earth will find September really the most constructive of all the months of the year.

The brain cells and the body cells have had a rest and have been given a new lease on life and energy. A renewal has been vouchsafed to thought and ambition. We enter quickly and avidly into the pressing problems of the hour, and our step is a bit more certain and our stride more accelerated than during other months when perchance we have become a little jaded and the keen edge of our activity has worn off.

Let us approach a certain problem that so worried us during the late months of winter and enervating months of spring when our

ambition had become dulled and our incentive had apparently gone to sleep. In September, we impulsively leap to our task, and ten to one we have it solved almost in the twinkling of an eye. Our vision is fresh, our instincts unerring, and we are able to accomplish more in a given time than in the turgid days of midsummer. It is true that in September we occasionally encounter some heated days that try the soul, but usually the nights cool off and there is a crispness in the air that drives the sleeper to draw the covers over him and snuggle into a warmer berth.

Mayhap a listener at the full denture section of our annual meeting has been given a hint by the essayist that turns his thought toward the solution of the retention of a lower full denture; mayhap, in another section, a suggestion has been made whereby a gold inlay may be more securely anchored; mayhap, after listening to a well-considered paper by another essayist, a clearer vision has been given to the mooted question whether to retain and treat a pulpless tooth or to extract it; mayhap, at this same midsummer meeting, a ray of light has been contributed on the relation of diet to dental caries; and, above all, should it be considered far-fetched to imagine that, after mature deliberation, a more intelligent reaction should be had to the condition of the supporting structures of the teeth, whereby we should have a clearer understanding as to when to save and when to extract?

The month of September at once launches on our vision a wide and varied field of conjecture that is most fascinating to contemplate, and it comes at a time in the year when we should be in the best possible condition to approach it with clarity and enthusiasm.

If any month should inspire us, it is September, and thus with all of these problems before us, we should be moved to our very best efforts, and enter with enthusiasm and alacrity on the coming autumn's work. Yet we fear that there are too many of our members who seem inclined to hesitate and loiter at this season of the year. For some unaccountable reason, they do not appear to be able to "snap into it" and get quickly into action.

Instead of plunging resolutely into the cool refreshing waters of virile thought, they linger at the brink waiting for something to turn up to move them into action. Nothing ever turns up worth

while in dental thought without incentive and initiative. We should bare our breasts to the bombardment of conflicting thought, and be prepared to give and take in the alluring game of science.

Stagnation is the enemy of advancement in all lines of endeavor, but never more so than in professional and scientific thought. The moment a dentist returns from his vacation, he should at once step into the arena and be prepared to battle for the benefit of his fellow practitioners, which really means for his fellowmen.

September is the month of renewed possibilities and of unfolding vision. Let us look forward to it with enthusiasm and determination —enthusiasm for our work, and determination to see that our work is constructive and well done.

THE SALIVARY FACTOR IN DENTAL CARIES

WHEN Miller finally succeeded in establishing the chemico-parasitic theory of dental caries, the whole mental trend of the dental profession turned immediately to the attack of the problem of correction and prevention of caries from the purely local approach —the effort to keep the teeth and mouth clean and thus prevent the presence of the bacteria which form lactic acid, the acid active in the decalcification of the enamel.

The enthusiastic practitioners of the profession undertook the herculean task of cleaning and keeping clean the mouths of all their patients and at the same time undertook to teach the public the reasons for and the desirability of keeping the teeth and mouth clean —prevention of the presence and development of the bacteria that were responsible for lactic acid formation and subsequent caries. While the profession has since realized the utter impracticability and impossibility of complete relief from that source, the knowledge gained from Miller's work did much to inculcate an appreciation on the part of the dentist and, through him, the public of the benefits to be gained from cleanliness of the oral cavity.

And thus was laid the foundation for the oral hygiene campaign which did much toward making the public dental minded. The profession also convinced itself that the cause of caries was more

than mere uncleanliness, that the conditions favoring caries were systemic as well as environmental and that both aspects needed to be studied more seriously. Among the numerous factors subsequently considered was that of the chemistry of the saliva in its rôle as a determining influence upon the environmental conditions which favor the development of dental caries.

Various dental research workers attacked the study of saliva from the standpoint of its chemical relationship to dental caries, but the requirements for successful study from this direction seemed beyond the scope of the dentist. The problem required the knowledge and directive suggestion, as well as breadth of vision, of the biochemist, particularly his knowledge of the chemical constitution of the mouth fluids as indicators of systemic conditions and their relation to local environment in determining the balance between susceptibility and immunity of the individual to dental caries.

In view of the collaborative research that seemed necessary, with its attendant difficulties, few dental workers seemed to maintain and sustain interest after the complexity of the problem was impressed upon them. However, sufficient encouragement, as well as suggestive results, were derived from the work of the various dental searchers to implant very definitely the idea that the salivary factor was an important one in the causation of dental caries and one that must necessarily be carefully studied before the whole story could be told.

On several occasions, we have expressed our belief that an understanding of this factor would lead toward the solution of our greatest problem, and we have also expressed the hope that the time would come when scientists in related biological fields could be sufficiently interested in the problem to help us solve it.

In the August issue, also in the present issue and in the October issue, we are pleased indeed to present a series of articles on enamel decalcification by mouth organisms and dental caries by L. S. Fosdick, Ph.D., H. L. Hansen, Ph.D., G. D. Wessinger, M.S., and Charlotte Epple, B.S., that has much of promise in clearing up many of the complexities of the salivary factor in dental caries. This group of workers in associated biological fields present a most enlightening study of the chemico-bacterial aspect of the fluids of the

mouth in their possible causal relation to dental caries. These authors hold forth the hope that, through these and further studies in this field, we may be able at a near future time to determine the susceptibility or immunity of the individual through analysis of the fluids of the mouth.

Their studies of the symbiotic relation of the mouth bacteria offer much hope toward clearing up the mysteries surrounding the bacteria concerned in lactic acid formation. Their suggestive findings in the study of the symbiotic relation of bacteria offer much scope for speculation as to the presence or absence of *Bacillus acidophilus* as a constant factor in caries. They find *Bacillus acidophilus* an almost constant inhabitant of the mouth fluids, but it is only active in lactic acid production in the presence of and associated with certain other bacteria.

While the authors do not claim to have finally solved any phase of the caries problem, they are much encouraged by their work, and foster the hope and belief that much light will be shed on our problems by an intensive and extensive study of the chemico-bacterial aspects of the human saliva.

Study of the dietetic findings put forth in the past few years leads us to the belief that at least one of the important factors in the etiology of dental caries is inseparably bound up with the chemical constitution of the salivary fluids. And the work of the authors here under consideration affords us renewed strength in that belief.

The authors devote particular attention to the bacterial production of lactic acid from carbohydrate food in concealed places in the mouth, as did Miller and Black many years ago, but their apparent repetition of the work of Miller and Black is important because they have established the fact that there is a symbiotic bacterial relationship which has much to do with the production of lactic acid.

L. P. A.

DR. C. WILLARD CAMALIER, PRESIDENT A. D. A., 1937-1938

In the hurry and confusion incident to the publication of an editorial on the Atlantic City meeting in the August issue, we quite

inadvertently omitted noting the fact that Dr. C. Willard Camalier, Washington, D. C., was duly installed by the House of Delegates as President of the American Dental Association for 1937-1938.

We humbly apologize to Dr. Camalier for the unfortunate omission, with the assurance that it was purely an oversight on our part.

L. P. A.

Obituaries

DR. RODRIGUES OTTOLENGUI

(1861-1937)

DIED, Sunday, July 11, 1937, after a prolonged illness, at his home, 175 West Seventy-Second Street, New York City, Rodrigues Ottolengui, M.D.S., D.D.S., LL.D.

Dr. Ottolengui was born on March 15, 1861, in Charleston, South Carolina, the son of Daniel and Helen Rodrigues Ottolengui. His father was a newspaper man and playwright. His grandfather on his mother's side was Dr. B. A. Rodrigues, a famous dentist of Charleston, S. C., who played an important and prominent part in the pioneer days in the establishment of dentistry in the South as a worthy specialty of the great healing art. He obtained his early education in the schools of South Carolina, and with the desire and determination to practise dentistry as a heritage from his venerable grandfather, in his early manhood he went to New York City and began an apprenticeship in dentistry under the late famed and revered Norman W. Kingsley, whose assistant and associate he later became. In his early years of association with Dr. Kingsley, he became acquainted with the late Dr. W. A. Atkinson, of New York City, which acquaintanceship and association exerted a strong influence upon his later career.

Soon after his entrance into dentistry, he took a lively interest in its affairs and, with the assumption of the editorship of the *Dental Items of Interest* in 1896, he became an aggressive leader of dentistry through a period of its history when the character, direction and course of its future were definitely determined and through a period when the influence of such leaders as he gave an impetus to a young and virile profession for rapid development that has seldom been equalled in the professional world. Of the energetic, dynamic, aggressive type, Dr. Ottolengui was always eager to be doing things, and he took an active part in practically every phase of dental activity. His positive personality, reinforced by sincerity of interest in the welfare of dentistry, made desire for progress almost an obsession with him, and with his ability as a writer, with one of the leading magazines as a vehicle for his thoughts, he contributed much to dentistry's progress.

His was a gifted controversial style of speech and writing; with a penchant for

the analytical, he had few peers in the many and important debates that took place in his time on the convention floors and in the magazines.

Indeed, as one of his biographers has remarked, "with the passing of Dr. Ottolengui, dentistry has lost an outstanding leader and a pioneer in dental science and literature" and a champion of the welfare of dentistry who took second place to no one in his enthusiastic and sincere loyalty. His broad knowledge of dentistry and his ready pen

DR. RODRIGUES OTTOLENGUI
(1861-1937)

made the "Around the Table" department of the "Items" a most popular forum of dental debate for many years. Then, too, outside the realm of dentistry, he achieved much fame—in the fields of entomology, taxidermy and detective story writing.

Dr. Ottolengui specialized in orthodontia and root-canal therapy. He was one of

the first dentists to use x-rays as an aid in diagnosis and in root-canal therapy. Some few years ago a collection of his dental writings were published under the title of "Table Talks on Dentistry."

COLONEL ROBERT TODD OLIVER

(1868-1937)

It is with deep regret and inarticulate sorrow that we mark the passing of Colonel Robert Todd Oliver, U. S. Army, Retired, at Walter Reed General Hospital, Washington, D. C., July 11, 1937. For years the Chief of the Dental Corps of the United States Army, he won the love and admiration not only of his corps but of the entire military and civilian dental and medical profession as well. He well deserved the honor bestowed on him by the American Dental Association in electing him their President of the Association on the eve of his retirement from active military service in January 1932. Because of his broad understanding of the science and art of dentistry, his unusual executive and administrative ability, his high reputation as a teacher and his years of experience as the senior officer in both age and rank in the Army Dental Corps, he justly earned the many high honors and citations accorded him by his profession and by a grateful government.

Colonel Oliver was born in Indianapolis, Ind., January 25, 1868; son of Dr. Dandridge Holladay Oliver and Theresa Jane Hedderly Oliver, and received his early education in the public schools of that city and at Butler College. He was a graduate of the Indiana Dental College (now School of Dentistry, Indiana University) in the class of 1888, and shortly thereafter became professor of oral surgery at that institution and president of the Indiana State Board of Dental Examiners.

His military service began, coincidently, in the Indiana National Guard, where, for a period of twelve years, he served in the grades from private to captain. At the outbreak of the Spanish American War, he was serving as "captain-adjutant" of four batteries of Indiana Light Artillery, when he volunteered his services to his country in the impending crisis. In order to be among those first mustered into federal service and ordered to the front, he resigned his commission and accepted a warrant, May 10, 1898, as quartermaster sergeant of the federalized Twenty-seventh Indiana Battery of Light Artillery, which became an integral part of the artillery brigade of the First Division, First Corps, under General Miles. His war service with this unit included the Puerto Rican Occupation.

On the advent of the Philippine Insurrection, his soldierly instincts and sincere patriotism impelled him to give up a thriving dental practice in Indianapolis and again offer his services to his country. Seeing the need for a corps of dentists in the army in the field, he and two other dentists prevailed on the War Department to appoint them, February 11, 1901, as Contract Dental Surgeons, U. S. Army, and as such he was ordered to duty with the Army in the Philippines under General Chaffee. Thus was born the Army Dental Corps of today.

After this war, years were devoted to the task of organizing, developing, training and fighting for the recognition of the military dentists as a professionally trained dental corps of regular officers and enlisted technical operators.

Dr. Oliver's efforts were rewarded when he and his corps were accepted on a permanent basis as "Army Dental Surgeons," beginning with his appointment as such, April 14, 1911 and later with the award of normal promotion to them, June 3, 1916, at which time he was promoted to Captain, Dental Surgeon, U. S. Army. He took an active part in the Mexican Punitive Expedition in 1916.

COLONEL ROBERT TODD OLIVER
(1868-1937)

With the entrance of the United States in the World War, and at General Pershing's personal request, Captain Oliver was ordered to France among the first, as the Chief of the Dental Corps of the American Expeditionary Forces. Soon after his arrival in France, he was promoted to the rank of Colonel, Dental Corps, U. S.

Army, which he held until his death. The story of his brilliant and meritorious service in the A.E.F. might be summed up in the terse General Orders No. 103, U. S. War Department 1919, which awarded him the Distinguished Service Medal as follows: "As Chief Dental Surgeon, he displayed remarkable ability in the performance of his numerous and exacting duties. He directed the personnel, equipment and operations of his department with sound judgment, showing resourcefulness in solving new problems which confronted him." In appreciation of his service to the Allies, the Republic of France bestowed on him the Legion of Honor (Officer) and the Double Palm d'Academie (Officer), the latter in appreciation of his organization of technical military dental schools within that country.

After the World War, he returned to Washington as Chief of the Dental Division, Office of the Surgeon General. In 1926, he was ordered to duty as professor of military science and tactics at Evans Institute (Dental School), University of Pennsylvania, Philadelphia, and served as such until his retirement from active duty January 25, 1932, at sixty-four years of age.

In addition to medals of award for service in the Spanish American War, 1898, the Puerto Rican Occupation, 1898, the Philippine Insurrection, 1901-02, and the Mexican Punitive Expedition, 1916, he was decorated with the Distinguished Service Medal of the United States Government, and the Legion of Honor (Officer), Republic of France.

Colonel Oliver is survived by his widow, Mrs. Ann Rockey Oliver, Washington, D. C., and by his son, Captain Robert Chaffee Oliver, Air Corps, U. S. Army.

DR. CHARLES LAWRENCE DRAIN

(1894-1937)

DIED, at his home in Iowa City, Iowa, June 5, 1937, from injuries received in an automobile accident, in his forty-third year, Charles Lawrence Drain, D.D.S.

Dr. Drain was graduated from the College of Dentistry at the University of Iowa in June 1917. After several years' service in the Dental Corps of the Army, he returned to private practice. He was appointed lecturer and instructor in pedodontia in the State University of Iowa, College of Dentistry, earning well-deserved promotions until he was made professor in 1936. In addition to his teaching activities, Dr. Drain was actively engaged in research on problems in dental caries, collaborating with Drs. Jean and Boyd of the Department of Pediatrics in the University of Iowa, College of Medicine, and in this work had made an important contribution to scientific research.

ASSOCIATION ACTIVITIES

A.D.A. GROUP INSURANCE

REPORT OF COMMITTEE

To the Board of Trustees of the American Dental Association:

IN presenting the committee report for the past year, it is with great pride that your committee can show the first increase in the number of certificate holders since 1931.

This condition was made possible by inspiring confidence of our members in the following manner: A letter was sent to each insured member, signed by our committee and stressing the following points:

1. The financial responsibility of the Great-West Life Assurance Company is unquestioned.

2. The service given our members and their beneficiaries by those handling the insurance has been excellent.

3. The low cost of this type of insurance has been properly safeguarded by the plan of insurance, which is found to be sound from an underwriting standpoint. With the addition of a new right of conversion to an individual policy by persons as they reach age 51, which was secured through the instigation of the Insurance Committee, the one objection has been largely eliminated for those now insured and entirely eliminated for future insureds, by allowing the permanent retention of the full $3,000 amount.

A letter was sent to each state president and secretary, also local and district society officers, notifying them of the above finding by our committee. In order to satisfy myself, feeling as I do the responsibility as chairman, I made an unannounced visit to Dr. Richmond's office in Kansas City, Kan., to investigate the mechanical progress of premium collection and solicitation of new prospective policy holders and I am glad to report the administration of his office was found efficient, economical and advantageous in every respect.

In regard to our financial relations with the Great-West Life Assurance Company, we are much gratified by Mr. Martin's announcement that a dividend has been set aside for all certificate holders up to June 30, 1937, and each man will receive a credit of $1.00 on his next payment, which makes in the aggregate a dividend of $6,160. This dividend is another evidence to your committee of the fairness of our carrying company.

Since we have the whole-hearted recommendation of the American Dental Association backed by a long period of investigation by the Committee on Insurance, we hope for a great increase in certificate holders during the coming fiscal year, and this hope is based on a steady list of new applications averaging from fifteen to twenty each day during the past three weeks.

Respectfully submitted,

A. D. WEAKLEY, *Chairman*,
1029 Vermont Ave.,
Washington, D. C.

FRED A. RICHMOND, *Secretary*,
U. G. RICKERT,
H. E. SUMMERS,
L. E. NIGHTENGALE.

COMMITTEE ON LEGISLATION*

THE Federal Trade Commission has recently issued a Cease and Desist order against the Hod Laboratory of Tampa, Fla., and J. M. Bette and John Alger, co-partners trading under the name of the Alger Dental Laboratories, Chicago, Ill.

The stipulation accepted by the Commission and signed by these men was somewhat similar to that previously signed by S. B. Heininger of Chicago, another mail order denture vender, whose Illinois license to practice dentistry was revoked by the Illinois Department of Registration and Education on May 6.

The Federal Post Office Department has for some time been making an extensive investigation of those conducting a business in mail order dentures, and it is to be hoped that further action by these Federal Government departments will outlaw this practice of dentistry by mail, which has been condemned by the American Dental Association as pernicious and against public welfare and health. By the latter stipulation filed by the Federal Trade Commission, the Hod Laboratory of Tampa, with J. M. Bette and John Alger, of Chicago, are ordered to "cease and desist" from representing directly or otherwise:

A. That respondents' false teeth are double tested.

B. That respondents' dental plates are better than those made by dental practitioners.

C. That in fitting or manufacture of said dental plates or false teeth, respondents use new methods or that in such fitting or manufacture precision is insured.

D. That respondents employ the most skilled workmen or experts that money can hire.

E. That from impressions made by purchasers or prospective purchasers respondents can or do make dental plates that can always be relied upon to

(1) Restore one's ability to chew properly; or

(2) Bring back one's natural contour; or

(3) Give a more youthful appearance; or

(4) Fit comfortably or accurately; or

(5) Perform the functions of natural teeth; or

(6) Improve one's health.

F. That a person who exercises care in following instructions can always procure dental plates or false teeth from the respondents that fit perfectly.

G. That respondents' false teeth or dental plates are unbreakable; and from making any other claims or assertions of like import.

*Excerpt from Annual Report of Committee on Legislation.

REPORT BY MR. HARTER, FROM THE COMMITTEE ON MILITARY AFFAIRS, HOUSE OF REPRESENTATIVES, 75TH CONGRESS, JULY 28, 1937, ON SENATE BILL 2463, "AUTHORIZING AN ADDITIONAL NUMBER OF MEDICAL AND DENTAL OFFICERS FOR THE ARMY"

MR. HARTER, from the Committee on Military Affairs, submitted the following

REPORT

[To accompany S. 2463]

The Committee on Military Affairs, to whom was referred the bill (S. 2463) to authorize an additional number of medical and dental officers for the Army, having considered the same, submit the following report thereon with the recommendation that it do pass with the following amendments:

Strike all out after the enacting clause and insert in lieu thereof the following:

That section 10 of the Act entitled "An Act for making further and more effectual provisions for the national defense and for other purposes," approved June 3, 1936, be amended by providing that on and after July 1, 1937, there shall be officers as now authorized by law, except that there shall be four assistants to the Surgeon General with the rank of brigadier general, one of whom shall be an officer in the Dental Corps, and 1,183 officers of the Medical Corps and 258 officers of the Dental Corps.

SEC. 2. That the Act entitled "An Act to authorize officers of the Medical Corps to count certain service in computing their rights in retirement and for other purposes," approved May 29, 1928, be amended by adding at the end thereof "service as contract dental surgeons and acting dental surgeons shall be credited to the officers of the Dental Corps for the purpose of retirement."

This measure proposes to increase the authorized commissioned strength of the Army Medical Corps and the authorized commissioned strength of the Army Dental Corps. The appropriation act of 1922 fixed the number of officers in the Medical Corps of the Army at 983 and the number in the Dental Corps at 158. The increase in enlisted strength of the Army has placed a great burden on both the Medical and the Dental Corps. The 1937 appropriation act carried funds for an increase of 50 officers in the Medical Corps and an increase of 25 officers in the Dental Corps.

The House Military Affairs Committee finds upon investigation that there is still a shortage of 150 medical and 75 dental officers required to enable the Medical Department of the Army to carry on its peacetime functions, i.e., to meet conditions brought about by expansion of demands upon the Medical Department which have been taking place over the past 15 years, viz: (1) Dispersion of troops; (2) increase of Air Corps stations; (3) development of a greater number of hospitals doing definitive medical work; (4) increased demands in the field of medicomilitary training, Regular Army, National Guard, and Organized Reserves, citizens' military training camps, and Reserve Officers' Training Corps; (5) increased responsibility in the field of preventive medicine; (6) steady progress in the scientific development of medicine; (7) extension of medical care to Federal employees; (8) increase in the enlisted strength of the Regular Army from 118,750 to 165,000.

In 1931 the Air Corps required 50 medical officers to care for their needs. It now requires 72 and as the Air Corps program develops it will require well over a hundred. These officers all require special professional training to be wholly proficient with this highly specialized service.

During the past 25 years, the character of service rendered by all Army hospitals has materially improved in keeping with civil hospitals. Through the efforts of the council on medical education and hospitals, American Medical Association, there has been an enormous increase in hospitals throughout the country, modernly equipped and adequately staffed in accordance with fixed standards. In order to keep pace and to furnish professional care to Army sick equivalent to that in civil life the Medical Department has been subjected to a heavy strain.

Wartime experience has shown that the medical officer in order to render efficient service with combined arms in combat must have a tactical and command knowledge of the function and disposition of Medical Department field elements, especially in the theater of operations. In addition to qualifying our own officers in

the duties of field service, it is essential to maintain schools of instruction to qualify a sufficient number of medical officers in the medicomilitary art and to provide instruction for the Medical Reserve Corps and the National Guard. The present Medical Corps assignments to the civil components are far below the number required to discharge the responsibility imposed by law.

The mass concentration of troops of the present day would be impossible without an observance of the principles of preventive medicine. In peacetime, both in garrison and maneuver, constant control of environmental factors in the control of disease must be maintained.

Specialization has become the rule in the civil profession of medicine. The Army Medical Department recognizes this in the practice of medicine and, notwithstanding the handicaps imposed, has continued to keep pace with the civil profession. Such handicaps include the following: The necessity for generally qualifying all officers in any of the multitudinous duties they may be called upon to perform in peace or war, and the lack of time and funds to permit an adequate number of officers to undergo special courses at civil hospitals. Much credit is due to individual officers who have qualified themselves at their own expense, impelled by interest in some specialty.

In keeping with the policy of Government economy, medical officers of the Army are required to render professional service to extra-military activities of the Federal service. This includes examinations of prospective civil-service employees, special examinations of beneficiaries of the Veterans Administration, and treatment of cases falling under the provisions of the Federal Employees' Compensation Act.

The situation with respect to the Dental Corps calls for immediate action. Its needs are most imperative. Under the act of March 3, 1911, a ratio of one dental officer per 1,000 total strength of the Army was authorized. We know that since that time the dental professional has made great advances in the line of preventive medicine. In the more than 25 years following this authorization, the dental professional has become recognized as one of the most important specialties in the field of medicine. Its record of outstanding achievement and the benefits that it has brought to humanity, particularly in the United States, in the last quarter of a century are well recognized. When the strength of the Army Dental Corps was fixed at 158 officers this contemplated the needs of an Army of 125,000 men. The Appropriation Act of 1937, in dealing with an Army of 165,000, provides for an increase of only 25 officers, making a total of 183.

The military strength is no criterion of the number of persons entitled to dental treatment. In addition to the increased number of persons dental officers are required to care for, there are thousands of physical examinations to be made such as candidates for West Point, Reserve officers, citizens' military training camps, and Reserve Officers' Training Corps.

If 75 additional dental officers were supplied over a period of 3 years, there would be 1 dental officer for each 640 enlisted men of the Army, which is regarded as sufficient.

To recapitulate, the Army has need for 150 additional medical and 75 additional dental officers. They should not be inducted at one time but in three yearly increments for proper assimilation and training. The program inaugurated in the appropriation act for the fiscal year 1937 should, therefore, be continued.

This bill also provides an officer with

the rank of brigadier general in the Dental Corps. This, in the judgment of the committee, is a proper recognizance of the work of the corps. The measure also provides for an additional assistant to the Surgeon General of the Army with the rank of brigadier general.

Section 2 of this bill will credit dental officers with contract dental service for purposes of retirement. Such a provision applies now to medical officers who served as contract surgeons. This provision should be expanded in terms to cover service as contract dental surgeon or as acting dental surgeon.

The decision of the Judge Advocate General of the Army of November 28, 1932, states in substance that such credit is already provided by existing law. This decision is noted in Supplement B of the Digest of Opinions of the Judge Advocate General of the Army, 1912-30, containing opinions of 1931 to 1935:

560a. The combined operation of the act of October 6, 1917 (40 Stat. 397); United States Code 10:121, and the act of May 29, 1928 (45 Stat. 996); United States Code 10:953a, entitles dental officers to count toward retirement service as contract dental surgeon or service as acting dental surgeon (210.85, November 28, 1932).

However, as this decision seems to determine administratively the right to retire, there remains in the minds of dental officers the possibility that the same opinion may not be held by the Comptroller when it comes to the pay voucher. The provisions of this bill would definitely settle any such doubts. There are only 31 such officers in the Dental Corps. It is likely that few, if any, will be affected by this amendment.

Amended bill as recommended by the Committee on Military Affairs passed the House August 2, 1937, and is now in the Senate.

NATIONAL BOARD OF DENTAL EXAMINERS: SUCCESSFUL CANDIDATES, PARTS I AND II*

Atlanta-Southern Dental College
Herman L. Anderson
Norman C. Bailey, Jr.
Harry Fox
Felix Glickstein
L. George Parry
Donald Hebble Smith

University of Maryland School of Dentistry and the Baltimore College of Dental Surgery
Harry Aks
Curtis M. Beetham
Irving Berman
Kenneth F. Downes
Richard James Eamich
John Conrad Heck
Donald B. B. Jones
Melvin R. Leonard
Bernard M. Lewis
Milton S. Lubarsky
Robert A. Reed
Harry Ewell Riggin
Jack Shobin
William B. Simington
Raymond Edward Zeiner

Chicago College of Dental Surgery
Dental Department of Loyola University
Donald C. Crook
Henry Kahn
Otto Lynn Miller
Bernard B. Morgan
Lawrence B. Murphy

*The session for Part II was held May 7-8, 1937, in nine different centers.

John M. Peffers
George W. Sterk
Edward J. Ulip
Raymond E. Wiegel
Frank S. Wozniak, Jr.

School of Dentistry, Medical College of Virginia

Samuel E. Buxton, Jr.
Nathaniel Janiger
William Carl Kuhs
Benjamin C. Magun
Alexander L. Martone
Nathan Neyman
John J. Schneider, (P.G.)

Northwestern University Dental School

Polly Ayres
Samuel Binder
Frank A. Heath

St. Louis University School of Dentistry

Festo Edward C. Giese
Robert N. Hamm
William James Sunderman
Karl Keen Webber

State University of Iowa, College of Dentistry

James Edwin Berney
James M. Bolks
LaVerne B. Eicher
Don Joseph Galagan
Eldon John George
Charles J. Goldthwaite
Leo George Severa
Milo Curtiss Steninger
Wilbur D. Ulrich
Robert Frank Vane

Temple University School of Dentistry

Harold L. Brown
C. Elizabeth Kartzmark
John Z. McFarland

Tufts College Dental School

Frank Cavallo
Maurice Carroll Culhane
Philip Harry Pachios

University of Illinois, College of Dentistry

Casimir J. Siniarski

University of Minnesota, College of Dentistry

Abraham E. Kimeldorf

The Thomas Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania

John H. Bell
Morris L. Lenz
Ralph Edward Lewis
Jack B. Miller
Raymond Wilson Sawyer

University of Pittsburgh School of Dentistry

Ralph W. E. Cox, Jr.
Paul W. Harbaugh
Hyman D. Koch
Herbert G. Kweskin
Gilbert N. Robin

Washington University School of Dentistry

Gunter Schmidt

PER CAPITA CONTRIBUTION OF STATES TO DENTAL RELIEF FUND

The total amount contributed to the Relief Fund for the year ending June 30, 1937 was $20,771.87. About $10,000 of this was returned to the states to be used for relief purposes and $10,118.70 was granted for relief by the Commission.

The average contribution per member for each state is as follows:

Alabama	$ .38	Montana	$ .65
Arizona	1.00	Nebraska	.51
Arkansas	.21	Nevada	.43
California	.42	New Jersey	.42
Southern California	.43	New Mexico	.74
Colorado	.44	New York	1.09
Connecticut	.50	North Carolina	.41
District of Columbia	.49	North Dakota	.76
Florida	.62	Ohio	.45
Georgia	.26	Oklahoma	.25
Illinois	.41	Oregon	.49
Indiana	.35	Pennsylvania	.49
Iowa	.34	South Carolina	.38
Kansas	.69	South Dakota	.28
Kentucky	.48	Tennessee	.57
Louisiana	.53	Texas	1.00
Maine	.46	Utah	1.00
Maryland	.52	Virginia	.45
Massachusetts	.44	Washington	.35
Michigan	.34	West Virginia	.45
Minnesota	.38	Wisconsin	.36
Mississippi	.22	Wyoming	1.46
Missouri	1.19		

The following have not qualified to receive 50 per cent return of their contribution:

Army	$1.56	Vermont	$ .33
Delaware	.78	Navy	.39
Idaho	.68	U. S. Public Health Service	.73
Hawaii	.43	Veterans Administration	.56
New Hampshire	.49	Panama Canal Zone	.57
Rhode Island	.74		

It is interesting to note that many of the states that have not qualified to receive any return have contributed several times as much per member as some others that have qualified.

BUREAU OF PUBLIC RELATIONS

ATTENTION—STATE AND COMPONENT SOCIETIES

Dr. C. Willard Camalier, President of the American Dental Association, has adopted the following slogan for 1938: Dental Health for American Youth. He and the Board of Trustees of the Association are preparing a comprehensive program for the coming year built around this theme. In this space in the October issue of THE JOURNAL, President Camalier's letter will be published. Be prepared to cooperate with him in making 1938 a banner year in promoting preventive dentistry for children.

Remember the slogan: Dental Health for American Youth.

THE 1937 SCIENTIFIC AND HEALTH EXHIBIT SECTION

By GEORGE B. WINTER, D.D.S., St. Louis, Mo.

THE Board of Trustees of the American Dental Association has been considering for some time the enlargement of the Scientific and Health Exhibit Section at the Annual Session. The year 1937 was considered an opportune time because of the increased interest in public health manifested by the American Dental Association, the American Medical Association and the federal agencies.

A large amount of valuable research work in the field of dentistry is being carried on by universities and also by individuals. It is important that the results of this work and its influence on the progress in dentistry be brought immediately to the attention of the profession. The public, too, should be informed so that it may realize the great advancement being made in dental science. Furthermore, exhibits should offer an excellent means of promoting endowments for dental research, which, so far, have been quite rare.

It is undeniable that one of the best means of disseminating information about dental research is the scientific exhibit as presented at our annual meetings. Such exhibits have already been highly developed and used effectively by the American Medical Association. One of the main reasons that our scientific exhibits have not been sufficiently developed in the past is the fact that, usually, facilities for holding such exhibits were inadequate. Exhibit space in New Orleans was limited. The same was true at San Francisco. In addition, transportation costs kept many exhibitors from participating at both of those conventions. The convention facilities at Atlantic City this year were ideal and the Scientific and Health Exhibit was the largest and finest that the American Dental Association has ever had. Because our meeting was held

in what is probably the largest dental center in the world, it was possible to secure exhibits even from exhibitors to whom transportation costs were a very important item. Besides, we had the largest auditorium in which we have ever held a meeting, the floor space for setting up the exhibits being comparable in size to a football field. Since we had more space than was needed, no exhibitor was limited either in space or frontage; which made it possible for every exhibit to be displayed to the best advantage.

When considering invitations in the future from cities that wish to act as our hosts, serious study should be given to the facilities available for the Scientific and Health Exhibit Section.

Taking full advantage of the excellent facilities available this year, the Board of Trustees started a campaign to secure as many worth-while presentations as possible. The timely theme for the meeting chosen by the President, Dr. Miner, "Preventive Dentistry in the Interest of Health," was one that lent itself to the development of interesting exhibits. His plan of permitting the general public to view the exhibits was also excellent, as it helped promote popular interest in dental health.

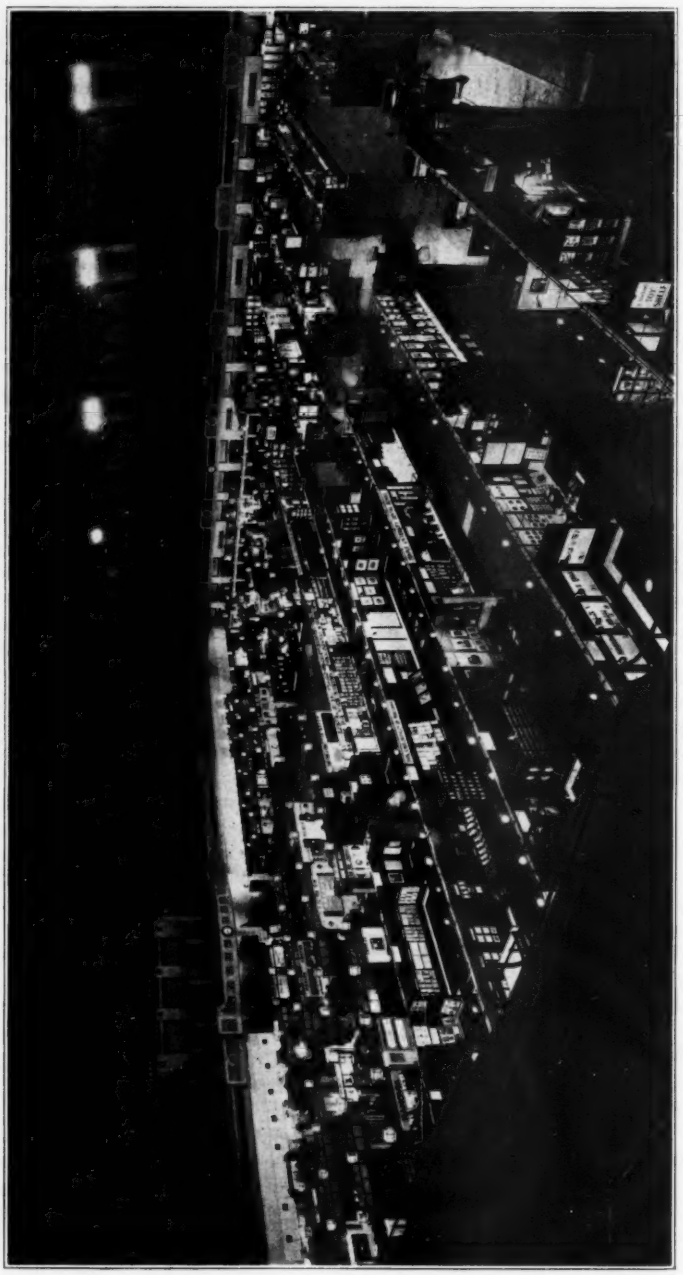
Under the able direction of Lon W. Morrey, Director of Exhibits; Frank J. Houghton, Chairman of the Exhibits Committee of the Local Arrangements Committee, and the committee appointed by the Board of Trustees, the country was combed for worth-while scientific and dental health exhibits.

Viewed from the balcony of the Auditorium, the exhibit section presented a picture of which dentistry can well be proud. Dental science and education both played an important part in the presentations. Well-arranged graphs, diagrams, models and other materials told more vividly and convincingly than words the story of advancement in both fields. Also, they were a convincing argument in favor of future development of this section because the story of progress in research work as well as in dental education was so vividly portrayed.

All in attendance could view the exhibits at their convenience as the booths were open throughout the entire meeting. The future should see a growth of interest in exhibits, if for no other reason than that all can gain full benefit from them at their leisure. Clinics or papers necessarily have only a limited audience because many of them are given simultaneously and cannot be repeated. Many people who viewed the exhibits on the opening day returned again and again to review them until the close on Friday. Some members of the Association believe that properly prepared scientific and health exhibits and table clinics are even more valuable than essays and lecture clinics because the latter are presented only once; whereas all have an opportunity to study the exhibits and table clinics at their convenience and to return to check facts, take notes and ask questions.

No one could fail to be impressed with the enthusiasm of the exhibitors and their desire to assist their audience so that the greatest possible good could be gained from the presentations. Even the public, who were not particularly interested in the exhibit subject matter, were impressed with the size, arrangement and decorative effect. The exhibits were so well arranged and grouped that they were pleasing to the eye individually and as a whole. It is hoped that future exhibit sections may be so enlarged that it will be possible to arrange the exhibits according to subject matter.

The committee was fortunate in securing such a large number of exhibits in all fields that each member and visitor could find timely, well-developed mate-



Scientific and Health Exhibit and Commercial Exhibits at the Seventy-Ninth Annual Session of the American Dental Association, Atlantic City, N. J., July 12-16, 1937.

rial in any field in which he was interested. However, all exhibits were so well prepared that each was of interest not only to specialists in that particular field, but also to the general practitioner, and to the public as well. Members of the American Dental Association can feel gratified by the fact that each exhibitor planned his material with such care that it was both artistic and scientifically accurate. All presentations were obviously the result of much thought, work and planning.

It was the general opinion that the Scientific and Health Exhibit Section was an outstanding feature of this year's meeting and that if it had not been developed to the size that it attained, the meeting might have been far less successful than it was.

Great interest was shown in the Motion Picture Section, but the results were somewhat disappointing because the screenings were not handled with as much dispatch as they should have been. However, it was not decided until a very short time prior to the convention to show motion pictures and adequate preparations could not be made.

It was the consensus of opinion that more interest was shown in this year's scientific and technical presentations than ever before. The general public took full advantage of the invitation to view the presentations and seemed genuinely interested.

That the exhibit this year interested the general public as well as the dentists and their wives, the hygienists and the dental assistants is gratifying to all who had a part in its planning. This interest demonstrated that exhibits can be an effective means of educating the public on the relationship of dentistry to public health and offers an opportunity to give them a better conception of the work of the profession.

At its last meeting, the American Medical Association filled the entire exhibit section of the Atlantic City Convention Hall. This we failed to do, but we did expand and enlarge our exhibit section so that we had over five times as many exhibits as in 1936. There is no reason that we should not, in the future, have as large a scientific and health exhibit section as the American Medical Association, since dentistry lends itself even better to visual presentation than does medicine.

All that is necessary to improve the exhibit section for 1938 is to arouse the interest of those who have material to present so that they will contribute the large, but essential, amount of time, effort, study and expense required to develop good material. The presentation of superior exhibits is undeniably an excellent way of serving and advancing the national organization and furthering the progress of the profession. Surely it will not be a difficut task to arouse such interest.

DEPARTMENT OF ORAL HYGIENE CINCINNATI PUBLIC SCHOOLS

THE first dental clinic in Cincinnati, Ohio, was opened in 1910, with one full-time chair. The cost of equipping and operating the clinic was borne by the Cincinnati Dental Society and contributors who were solicited by the members. The service was increased to three chairs in 1912, when part of the expense was met by the city. The service was gradually increased until, in 1919, there

were five full-time chairs operating in the schools. Up to this time, the funds were provided by the Cincinnati Dental Society and the city. In 1916, the board of education also contributed to the fund for dental service.

In 1925, the board of education took over all of the corrective work on a budget of $16,190. Since that time, one full-time chair has been added to the corrective service, and the budget of the board of education to cover this service increased gradually to a maximum of $36,420, in 1931. From that time on to the present, there has been a gradual decrease in the budget of the oral hygiene department for corrective service until, at the present time, the budget is $24,047. The reduction in budget has not caused a reduction in corrective service. To the contrary, there has been an increase in dental service owing to the greater effort of those employed in the dental department. The year 1934-1935 shows the greatest amount of work done in the history of the clinics.

In the last twenty-five years, 83,213 patients have had dental attention in the school clinics. The service rendered these children, not including minor treatments, is as follows: 69,566 prophylaxes, 120,827 extractions and 373,779 fillings; a total of 564,172 operations. To afford an idea of the cost of this corrective work, a report must be given for the period from 1926 to the present time, as accurate figures, especially on finances, are not available previous to that time: 29,684 prophylaxes, 65,002 extractions, 226,528 fillings, 152,701 visits and 38,075 patients. The cost of doing this work was $256,493, all of which was paid by the board of education for corrective service with the one exception that the Work Certificate Examining Clinic was also included in these figures. The itemized work report above does not include that of the Work Certificate Examining Clinic.

An important phase of the oral hygiene department activities is dental health education, carried on chiefly by the so-called prophylaxis clinics, which have a personnel composed of hygienists and their assistants. This work was initiated in 1924. The personnel of this department was gradually increased until 1929, when there was a maximum of six hygienists and three assistants. During the years 1929-1930-1931, two hygienists and one assistant were paid by the board of education. Their services were discontinued when the budget was reduced. This number was maintained for three years, when, in 1932, it was reduced to four. At present, the number is three.

The community chest furnishes the funds for this service and the budget for it in 1926 was $10,000. This budget was decreased in 1932 and again cut to the present minimum of $7,200, in 1933.

POLICIES OF THE DENTAL DEPARTMENT

There has been a gradual trend away from a policy of emergency treatment as it was found that such treatment did not have any really constructive results. At the present time, corrective clinics are not looked on as emergency stations to relieve pain. Most of the children who come into the clinics today do not come because of toothache, but because either their parents or some one in the school system is interested enough in preventing serious dental disease to seek proper attention for them before painful conditions result. This has been the real reason for the development of the prophylaxis clinics. These clinics accomplish the following work each year: 55,129 examinations, 1,443 prophylaxes and 687 lectures (given to 53,534 children).

RESULTS OF DENTAL HEALTH EDUCATION

It is difficult to point definitely to im-

provements on a large scale when a service is spread so thinly over a large number of children. However, there is one very definite instance of improvement in the mouths of school children. In 1932, the first examination was made at Withrow Junior High School. At that time, it was found that 33 per cent of children had lost one or more first permanent molars. This year, this examination showed that only 22 per cent had lost these important teeth; an improvement of 11 per cent over a period of six years.

There seems to be no good reason for this improvement other than the fact that these children have been attending school for six years previous to this time and have had a program of dental health education presented to them each year, and their mothers have had lectures on the subject in mothers' clubs each year. Another gratifying fact is the increase each year in the number of children who have dental attention annually. At the present time, the number of children reexamined is about 33,000, and two-thirds of them had been to the dentist within a year. Several years ago, the number was less than one-third.

This phase of the work could be developed further so that a check-up each year could be made in addition to the regular dental examination. This would be well worth while financially, to say nothing of the improvement in health conditions which would follow.

A.D.A. RADIO BROADCASTS OVER COLUMBIA NORTHWEST AND SOUTHWEST CHAINS

Through the cooperation of the Columbia Broadcasting System, the American Dental Association's weekly radio programs are being made available to the following stations at 12:15 p.m., Central Standard Time.

KNOW—Austin, Texas
KRLD—Dallas, Texas
KTRH—Houston, Texas
KLRA—Little Rock, Ark.
KOMA—Oklahoma City, Okla.
KTSA—San Antonio, Texas
KWKH—Shreveport, La.
KTUL—Tulsa, Okla.
WACO—Waco, Texas
KGKO—Wichita Falls, Texas
KFH—Wichita, Kan.
WIBW—Topeka, Kan.
WOC—Davenport, Iowa
WCCO—Minneapolis, Minn.
WNAX—Yankton, S. D.
KSCJ—Sioux City, Iowa
KFAB—Omaha, Nebr.
WTAQ—Green Bay, Wis.
WISN—Milwaukee, Wis.
WMBD—Peoria, Ill.
KRNT—Des Moines, Iowa
WKBB—Dubuque, Iowa

SUBJECTS AND DATES FOR THE COMING MONTH

September 7: Dental Description Helps Identify Deceased
September 14: Dentistry—An Aid in Identification
September 21: The Webster-Parkman Case
September 28: A Broken Tooth Puts Parolee Back in Prison (Dentistry Again Assists Detectives)

LOUISVILLE'S PREVENTIVE DENTAL PROGRAM

Louisville, Ky., is one of the latest cities to enter the field of preventive dentistry for children. W. D. Raley has been placed in charge of the dental educational department of the Louisville Health Department. Working with an advisory committee from the dental society, Dr. Raley plans an extensive program for the coming school year.

DENTAL ECONOMICS

REPORT OF ECONOMIC CONDITIONS BY DISTRICTS AND STATES

MAY 4, 1937, the Committee on Economics mailed the four questions below to all of its members and deputies. The voluminous and comprehensive replies received have proved very valuable. A résumé of the replies is given herewith.

QUESTIONS

1. Comment on the general economic conditions in your state.
2. Has 1936 dental practice improved over 1935?
3. Estimate the percentage of dentists' unoccupied time.
4. What is dentistry's part in your state and local health program?

REPLIES

1. *Comment on the general economic conditions in your state.*

District 1

Conn.: Good. Plants running three shifts, wages increased several times. No strikes.

Maine: Better than in 1936. Collections better.

Mass.: March business index in New England advanced from 108.9 to 115.5, highest since October 1929 and 27.8 per cent above March 1936.

N. H.: Improved, but not up to normal.

R. I.: Industry injured by C.I.O. strikes.

Vt.: Business almost up to normal, although dental collections have dropped below normal this Spring.

District 2

N.Y.: Better than in 1935. Reports from 160 dental laboratories indicate an increase of 21 per cent in laboratory sales to dentists.

District 3

Pa.: Upturn in business since 1934 of about 40 per cent. C.I.O. strikes in late Spring have been very injurious.

District 4

Del.: No report.

D. C.: No report.

Md.: Eleven of nineteen business barometers show a higher index figure for 1936 than for 1931.

N. J.: Decided upturn in heavy industry. General merchandising improved more than 37 per cent over last year. Dental practice improved about 17 per cent in 1936 over 1935. Additional report: Business in 1937 not quite so good as in 1936.

District 5

S. C.: No report.

Va.: No report.

Ala.: Strikes and threatened strikes causing great unrest. Farmers predict fair crops and prices.

Fla.: 1936 business 20 per cent better than 1935. Postal receipts, internal revenue collections and state revenue increased 11 per cent, 97.8 per cent and

19 per cent, respectively, in 1936 over 1935. Tourist business increased 15 per cent in 1936 over 1935. Commercial failures decreased 47.1 per cent in 1936 over 1935.

Ga.: General upward trend throughout entire state. Rural areas enjoying greater improvement than cities.

Miss.: Both general and dental economic conditions much improved over conditions of preceding years.

N. C.: Greatly improved, especially in eastern section.

District 6

Mo.: 100 per cent improvement in business, both general and dental.

Ky.: Money tight. Some improvement in general conditions. Flood repairs have increased merchandise sales. Real estate advancing.

Tenn.: Slight improvement over 1936.

W. Va.: General economic conditions greatly improved.

District 7

Ind.: Economic conditions in most of the state fairly good.

Ohio: Economic conditions much improved, but larger cities still suffer from enormous relief load.

District 8

Ill.: Economic condition much improved.

District 9

Mich.: No definite report.

Wis.: Much better. Collections much better.

District 10

Iowa: Unanswered. (Fifty-two counties reported improvement in dental practice, ten reported no improvement, one undecided. Sixty-three of ninety-nine counties replied to questionnaire sent out by state economic committee.)

Minn.: Definitely improving until the strikes of the past ninety days.

District 11

Mont.: Stock raising continues to suffer. Mining industry very active. Gold mining working to capacity.

Nebr.: General economic conditions better than last year although the past two months have not kept pace with earlier months of the year. Labor discord. Federal policies and rising retail prices are producing a "What next?" attitude.

N. D.: Quotation from March report of North Dakota Public Welfare Board: In March 1936, 25.43 per cent of the total population were receiving public assistance in the form of either direct or work relief, and in March 1937, 41.50 per cent received such aid. Rains may produce a crop this year. A crop will merely give a basis for hope of returns in 1938.

S. D.: General economic conditions no better than in 1935.

Ore.: General economic conditions improved. The state's financial condition unusually good.

Wash.: Business conditions in general greatly improved over 1936.

Idaho: Better in 1936; decided falling off in 1937.

District 12

Colo.: No report.

Kan.: No report.

N. M.: No report.

Okla.: 1936 about 5 to 10 per cent better than 1935. Increased oil activities offset bad agriculture. 1937 prospects are even brighter.

Ark.: General economic conditions improving.

Texas: General economic conditions are now better than for several years.

La.: General economic conditions present no serious problems.

District 13

Utah: Very much improved in fact and in thought.

Ariz.: Business conditions generally better.

Calif. (Northern): General economic conditions have nearly recovered from the depression era, although strike conditions in San Francisco are holding recovery in that city in abeyance. Efforts were made to organize the dental assistants under the C.I.O., but these efforts were thwarted for the present by the Dental Assistants' Association in San Francisco. Efforts to organize the assistants in the valley communities under C.I.O. have, so far, been unsuccessful. A C.I.O. charter has been issued to the dental technicians in San Francisco.

Calif. (Southern): No change noted since 1935.

Hawaii: General conditions improved.

Nev.: General economic conditions are improving. Living conditions are better and cost of living rising.

SUMMARY OF STATE ECONOMIC CONDITIONS

Thirty-five states reported conditions better. Estimates range from "some" or "a little" to 20, 28 and 40 per cent. One state reported 100 per cent improvement.

Seven states reported conditions unchanged.

Thirteen states made no direct reply to this question.

Five states reported business injured by C.I.O. strikes.

Districts 1, 2, 5, 6, 7, 8, 10 and 13 reported better economic conditions.

District 3 reported business better until recently injured by strikes.

District 9 reported business in Wisconsin improved; in Michigan injured by strikes.

District 11 reported better business except for North and South Dakota.

District 12 reported better conditions in four states. Three states made no report.

2. *Has 1936 dental practice improved over 1935?*

District 1

Conn.: Most dentists report an increase in 1936 over 1935.

Maine: Yes.

Mass.: Improved. One dental supply house reports a 17 per cent gain, one a 14.7 per cent, one a 6.5 per cent. Dental laboratory gains in 1936 over 1935 about 5 per cent.

N. H.: Yes.

R. I.: Some men very busy, others complain of poor business.

Vt.: No definite report.

District 2

N. Y.: From reports received from 160 laboratories, there seems to have been an increase of 21 per cent in laboratory sales to dentists.

District 3

Pa.: Estimated 25 per cent increase in dental practice in 1936 over 1935, although 1937 shows a distinct dropping off.

District 4

Del.: No report.

D. C.: No report.

Md.: Dental laboratories and dental supply houses report a 20 per cent increase in business in 1936 over 1935.

N. J.: 1936 improved about 17 per cent over 1935. The first five months of 1937 show an additional average increase of 20 per cent.

District 5

S. C.: No report.

Va.: No report.

Ala.: Improvement of 20.8 per cent in 1936 over 1935.

Fla.: From reports supplied by dental

dealers and laboratories, it is estimated that the professional income increased 27 per cent in 1936 over 1935.

Ga.: Dental income improved from 10 to 25 per cent in 1936 over 1935.

N. C.: Improved.

Miss.: At least 25 per cent.

District 6

Mo.: At least 100 per cent.

Ky.: Yes.

Tenn.: Slight improvement over 1936.

W. Va.: 1936 improved over 1935.

District 7

Ind.: Yes.

Ohio: About 25 per cent.

District 8

Ill.: Yes.

District 9

Mich.: No definite report.

Wis.: 1936 considerably better than 1935.

District 10

Iowa: Fifty-two of 99 counties reported "yes" and ten reported "no." One was undecided and the remainder did not reply.

Minn.: Definite improvement in 1936 over 1935.

District 11

Wyo.: No report.

Mont.: Dental practice in 1936 improved over 1935. Reports from dental supply houses indicate a drop in business in 1937.

Nebr.: Dental practice in 1936 was from 15 to 20 per cent better than in 1935. Practice in 1937 has dropped off some.

N. D.: A little improvement in the eastern part of the state and in isolated portions of the midsection. As a whole, probably less.

S. D.: No improvement.

Ore.: Yes.

Wash.: Very definitely.

Idaho: 1936 improved 15 per cent over 1935.

District 12

Colo.: No report.

Kan.: No report.

N. M.: No report.

Okla.: About 10 per cent. One section reports 100 per cent improvement.

Ark.: Dental practice in 1936 improved over 1935.

Texas: Yes, from 5 to 25 per cent. Another estimate says from 30 to 50 per cent over the depression years.

La.: Status of dental profession generally satisfactory. A number of dentists have been on W.P.A. projects, some on relief because of age and physical disabilities. A belief exists that a majority of dentists obtain no more than a living income from practice.

District 13

Utah: In most sections of the state.

Calif. (Southern): Little change noted since 1935. Collections during last quarter of 1936 were a little worse.

Ariz.: Dental conditions better.

Calif. (Northern): Dental conditions better.

Hawaii: Dental conditions better.

Nev.: 1936 improved over 1935.

SUMMARY OF CONDITIONS OF DENTAL PRACTICE IN 1936 AS COMPARED TO 1935

Thirty-seven states reported an improvement in dental practice in 1936 over 1935, although two of these states reported a dropping off during the first six months of 1937. Improvements estimated by thirteen states range from 5 to 100 per cent.

Three states reported no change. One of these believed that collections were a little worse during the latter part of 1936.

One state reported dental conditions worse.

Ten states did not reply.

Districts 1, 2, 6, 7, 8 and 10 reported dental conditions better.

District 3 reported dental conditions better in 1936, but dropping in 1937.

District 4 reported improvement in two states. Two states did not report.

District 5 reported dental conditions better in five states. Two states did not report.

District 9 reported dental conditions better in one state. One state did not report.

District 11 reported dental conditions better in four states; no improvement in one and conditions worse in one. There was no report from two states.

District 12 reported dental conditions better in four states. There was no report from three.

District 13 reported dental conditions better in five states and no improvement in one.

3. *Estimate the percentage of dentists' unoccupied time.*

SUMMARY

Of the twenty-three replies received from members who attempted to answer this question, the estimates ran from 10 to 66⅔ per cent, averaging about 31 per cent. In most instances, the replies were qualified with the statement that the figures were merely estimates and should not be considered definite.

Eighteen men replied that it was impossible or extremely difficult to answer this question.

Eleven did not report.

4. *What is dentistry's part in your state and local health program?*

District 1

Maine: State department of health employs three dental hygienists. Twelve city and county school programs employ approximately twenty-four full-time or part-time dentists and four dental hygienists. The Marine Hospital employs two dentists and the Veterans Bureau employs two dentists.

Mass.: State department of health employs two dentists, one dental hygienist; Boston Health department, sixteen dentists and eight hygienists. In addition, twenty-three communities have school dental clinics under the school departments. Fifty-one communities have school dental clinics under private organizations. Seventy-eight communities have school dental clinics under the board of health. Three communities have school dental clinics under the department of public welfare. Several towns in the state use the services of traveling dental clinics.

N. H.: Contemplating establishing a dental division in state department of health. Local departments of education do some dental work, but there is no fixed personnel.

R. I.: A dentist acts in an advisory capacity to the director of child welfare in the state department of public health. The department of public health also employs a dental hygienist.

Conn.: State department of health employs one dentist and five hygienists.

Vt.: State department of health employs one dentist and one hygienist.

District 2

N. Y.: One dentist on state board of education. New York City: One dental division chief, six supervisors, approximately 170 part-time dentists and 115 full-time and part-time hygienists. Complete reports from the balance of the state are not at hand, although in 1930 there were 125 hygienists employed as teachers of oral hygiene in communities other than New York City.

District 3

Pa.: State department of health, one dental director, who is a dentist, and eight hygienists. Philadelphia Department of Health, eleven health centers, one dental chief and seventeen dentists; numerous hospital dental clinics, two dental school clinics and mouth hygiene council. Philadelphia Dental Society, low-fee program for indigent and near indigent. Pittsburgh, school clinics, twelve dentists for emergency work. University of Pittsburgh clinic, Falk clinic, Montefiore Hospital and nine other hospitals provide clinic service. Odontological Society of Western Pennsylvania conducts dental programs for children in nine counties.

District 4

Del.: State board of health, one dental consultant and nine hygienists.

Md.: State department of health, one dental director and twenty-nine full-time and part-time dentists. Baltimore, sixteen health department school clinics employing one part-time supervisor and four part-time dentists.

N. J.: Information not complete. Newark Board of Education employs two and Newark Board of Health employs six part-time dentists. One hundred five school districts of 540 provide some type of dental treatment for children. These programs are administered by boards of education except in the cases of New Brunswick and Elizabeth, where they are administered by the board of health. Newark has clinics administered by the board of education and the board of health.

District 5

Ala.: State department of health, one dentist and one teacher.

Fla.: State department of health, one dental consultant, one dental director and one field dentist. Two dentists and one hygienist in county dental health program.

Ga.: State department of health, one dental consultant, and one dental educational director and one assistant (both teachers).

N. C.: State board of health, one dental director and twenty-two full-time dentists.

Miss.: State board of health, one dental supervisor (teacher) and thirteen field workers, consisting of twelve hygienists and one dentist.

S. C.: State department of health, one dental director.

Va.: State board of health, one dental director and eighteen dentists.

District 6

Mo.: One dentist in the dental division of the state department of health.

Ky.: State department of health, one dental director (no salary), three full-time and three part-time dentists. City and county boards of health, six part-time dentists.

Tenn.: State department of health, one dental director and one assistant.

W. Va.: No state program, but contemplating one. Hygienist in Kanawa Co., eleven full-time and part-time dentists and one hygienist in McDowell Co.

District 7

Ind.: State department of health, one dental director (dentist) and one field dentist. A few local communities employ dentists and hygienists, notably Gary and Indianapolis.

Ohio: State department of public health, one dentist and five hygienists. Cleveland and Cincinnati employ dentists and hygienists in their school health service.

District 8

Ill.: State department of health, one

director (dentist), three field dentists and three nurses. Chicago Board of Health employs twenty-eight full-time dentists and eighteen dental assistants. Chicago Municipal Tuberculosis Sanitarium employs nine half-time dentists. Cook Co. Children's Dispensary employs nine full-time dentists. At least ten other cities employ full-time or part-time dentists in school dental health work.

District 9

Mich.: State department of health, two dentists and one hygienist. Children's Fund of Michigan, approximately twenty-two dentists. Kellogg Fund of Michigan, one dentist. Information on local programs not complete.

Wis.: State department of health, one dentist. Milwaukee, six full-time and half-time dentists, five dental hygienists. Probably six other cities have school dental programs.

District 10

Iowa: State department of health, one dentist. Extension Division, Iowa University, one dentist. Twelve cities and counties employ part-time or full-time dentists.

Minn.: State department of health, one dentist. Between ten and fifteen school dentists in local communities. The Minneapolis Board of Education employs one part-time dental director and nine full-time hygienists. St. Paul, eight half-time dentists and three full-time hygienists on board of education. In addition, eight dentists were employed on a W. P. A. project for indigent children in 1935 and 1936 and three dentists and one intern employed in city and county hospital. Two private foundations employ one dentist each.

District 11

Idaho: None so far.

Mont.: Eight local or community public dental health programs, six of which are in state institutions, and two in public schools.

Nebr.: State department of public health, one dentist.

N. D.: Contemplating a state program.

S. D.: Contemplating a state program.

Ore.: State department of health, one dentist. No information on local programs.

Wash.: State department of health, one dentist. No information on local programs.

Wyo.: Not contemplating a dental program for state.

District 12

Colo.: Contemplating a state dental division.

Kan.: State department of public health, one dentist. Thirty or more local clinics of various types in the state.

Okla.: State department of health, two dentists. Oklahoma City, two part-time dentists.

Ark.: Hope to establish a state dental division.

Tex.: State department of health, one dentist. Six dentists employed in community dental health work.

N. M.: Not contemplating a state dental program.

La.: Contemplating a state dental program. Full-time dentist with mobile unit in Caddo Parish.

District 13

Calif.: Dentistry is acting in an advisory capacity to state board of health. A recent law specifies that one member of the board of health shall be a dentist. State department of health, two dentists with trailer outfits to examine and educate children in rural communities. San Francisco, Los Angeles, Los Angeles Co. and Long Beach employ school dentists.

Utah: State department of health, one dentist. Salt Lake City, four part-time dentists.

Ariz.: Not planning to establish a state dental program.

Hawaii: Palama settlement dental clinic, ten full-time dentists and six assistants and attendants. In addition, one supervising hygienist and twenty-five dental hygienists employed full time.

Nev.: Planning to employ a dentist and possibly dental hygienist in state department of health.

DENTISTRY'S PART IN STATE AND LOCAL HEALTH PROGRAMS: SUMMARY

Thirty-four states now include preventive dentistry as part of their public health activities. In thirty of these states, the program is confined to the dissemination of educational material.

Four state programs include some operative procedures for indigent children, performed for educational purposes.

Ten states are contemplating the establishment of dental divisions.

Three states report that they are not contemplating a division of this kind.

One replied "no program so far."

The reports on the local dental health programs in the various states are not complete. A few states have made comprehensive surveys on this question and know quite definitely the number and kind of local programs in operation. On the whole, little attention has been paid to this phase of dentistry. The economic committee of each state should have full information on this subject.

CONCLUSION AND RECOMMENDATIONS

With the present set-up in the A.D.A. and the state societies, this and other economic information could easily be obtained and kept on record. More difficulty would be encountered in obtaining authentic information regarding the percentage of dentist's time that is unoccupied, but even this is not impossible once proper standards of time are established. By a study of chamber of commerce statistics, Pennsylvania was able to make a very comprehensive report on general economic conditions. By direct contact with each county, Iowa was able to make a fine report on general and dental conditions. It is suggested that every state do likewise.

COUNCIL ON DENTAL THERAPEUTICS

ACCEPTED DENTAL REMEDIES

The following articles have been accepted as conforming to the rules of the Council on Dental Therapeutics of the American Dental Association. The Council wishes dentists to understand that the admission of an article does not imply a recommendation. A copy of the rules that govern the Council in the consideration of articles will be sent on request.

SAMUEL M. GORDON, *Secretary.*

LOCAL ANESTHETICS*

Procaine Solution 2% with Epinephrine 1:50,000-Pfingst:

Each cubic centimeter is stated to contain procaine hydrochloride, 0.02 gm., epinephrine as sulfate, 0.00002 gm., sodium chloride, 0.007 gm., potassium chloride, 0.0003 gm., calcium chloride, 0.00025 gm., sodium bisulfite, 0.0022 gm., and distilled water, q.s.

Manufactured by the Procaine Co., Inc., New York City. Distributed by A. Pfingst, New York City. No U. S. patent or trademark.

Procaine Solution 2% with Epinephrine 1:50,000-Pfingst in Cartridges.

Procaine Solution 2% with Epinephrine 1:25,000-Pfingst:

Each cubic centimeter is stated to contain procaine hydrochloride, 0.02 gm., epinephrine as sulfate, 0.00004 gm., sodium chloride, 0.007 gm., potassium chloride, 0.0003 gm., calcium chloride, 0.00025 gm., sodium bisulfite, 0.0022 gm., distilled water, q.s.

Manufactured by the Procaine Co., Inc., New York City. Distributed by A. Pfingst, New York City. No U. S. patent or trademark.

Procaine Solution 2% with Epinephrine 1:25,000-Pfingst in Cartridges.

DENTIFRICES†

Halesworth Tooth Paste.—Composition: See Sheffield Tooth Paste (A.D.R. 1937, p. 110).

Manufactured by the Sheffield Company, New London, Conn. Distributed by Hale Bros. Stores, Inc., San Francisco, Calif.

Amalgamated (Brand) Tooth Paste.—Composition: See Sheffield Tooth Paste (A.D.R. 1937, p. 110).

Manufactured by the Sheffield Company, New London, Conn. Distributed by Amalgamated Clothing Workers of America (Dental Department), Chicago, Ill.

Friend's Tooth Paste.—Composition: See Sheffield Tooth Paste (A.D.R. 1937, p. 110).

Manufactured by the Sheffield Company, New London, Conn. Distributed by Friendly House, Lynchburg, Va.

*A.D.R. 1937, p. 36.

†A.D.R. 1937, p. 105.

THE FEDERAL TRADE COMMISSION VERSUS PHILLIPS' MILK OF MAGNESIA TOOTH PASTE, IPANA AND KOLYNOS

The Chas. H. Phillips Chemical Company, 170 Varick Street, New York, advertisers of Phillips' Milk of Magnesia Tooth Paste, has stipulated with the Federal Trade Commission that "it will not advertise Phillips' Milk of Magnesia Tooth Paste as providing the best way yet discovered or as science's latest discovery for cleaning teeth"; that "the respondent company will also cease asserting that its tooth paste contains more milk of magnesia than any other tooth paste, unless such representation is true at the time it is made," and that "the respondent company admits in its stipulation that there is no evidence that its dentifrice contains more milk of magnesia than any other tooth paste." The Council has pointed out that, strictly speaking, milk of magnesia dentifrices do not exist.

Chas. H. Phillips Chemical Co. is part of Sterling Products (Incorporated), a holding company. Another part of Sterling Products (Incorporated) is the R. L. Watkins Company, advertisers of Dr. Lyon's Tooth Powder. The popular slogan of Dr. Lyon's Tooth Powder is "Do as your dentist does—use powder." One wonders how the parent company reconciles these varying claims.

Ziratol and Ipana Tooth Paste were the subject of a report of the Council (J.A.D.A., 21:2223, December 1934) holding both of these products not acceptable for A.D.R. The Council at various times stated that this product was advertised with therapeutic claims, possibly because of its content of betanaphthol, which is contained in ziratol. Now the advertisting of the Bristol Myers Company, to which the Council previously objected, has run afoul of the Federal Trade Commission. According to a press release of the Commission dated June 24, 1937, the Bristol Myers Company of New York, manufacturers of Sal Hepatica, another unacceptable preparation (J.A.D.A., 22:854, May 1935) have stipulated with the Federal Trade Commission that certain false and misleading advertising practices will be discontinued, in the sale of Ipana Tooth Paste. They will cease advertising "that this preparation and massaging will correct any unhealthy gum condition; that Ipana and the use of a tooth brush will restore to the gums the stimulation they need to remain firm and healthy; that modern dental science or the country's dentists urge or approve the use of Ipana and massaging in the care of the teeth and gums, and that Ipana and massaging will prevent one from becoming a 'dental cripple.'"

It will be interesting to observe the future advertising of these products. Dentists have long ago provided themselves with certain standards by which to judge the acceptability of dentifrices and their advertising. Far-sighted firms have accepted these conditions; short-sighted ones insist on finding in a dentifrice more than a cleansing agent.

The Federal Trade Commission has ordered Kolynos Co., New Haven, Conn., to cease and desist from making certain false and misleading representations in connection with the interstate sale of Kolynos tooth paste.

Among representations prohibited in advertising are that Kolynos tooth paste conquers "bacterial mouth," allegedly caused by germs which attack tooth and gum; cleans and polishes teeth down to the naked white enamel and erases and removes tartar; gives teeth a double cleansing not to be obtained with ordinary or other dentifrices and restores all teeth to sparkling or natural whiteness.

The respondent company also is ordered to cease representing that Kolynos tooth paste is new or totally different from other dentifrices; does for the teeth and gums what ordinary or other dentifrices cannot do and is "the approved" tooth paste or "the" antiseptic dental cream, in the sense of having been approved or recommended by dentists or the purchasing public to the exclusion of other tooth pastes and dentifrices.

THE p_H OF STOCK PROCAINE SOLUTIONS

By LOUIS I. GROSSMAN, D.D.S., Dr. Med. Dent. (Rostock)., Philadelphia, Pa.

Within the last few years, much attention has been given to the p_H of stock solutions of local anesthetics. Claims for stability were made despite the absence of data; or when the data showed a stability of a relatively short period of time, claims of stability over longer periods were made. The Secretary of the Council suggested to Louis I. Grossman, of Philadelphia, a study of the p_H of stock procaine solutions. The results of Dr. Grossman's work are in line with other evidence available to the Council. The Council examined the report and authorized its publication as a report of the Council.

In so doing, the Council desires to express its appreciation of the manner in which the investigation was carried out and the spirit which prompted the publication of these results. The Council accepts the conclusions of Dr. Grossman. Advertising that pertains to this investigation will be viewed in the light of these results unless contrary evidence is forthcoming.

SAMUEL M. GORDON, *Secretary.*

Despite the fact that hundreds of thousands of containers of stock procaine solutions are sold annually to the dental and medical professions, no independent investigation of the p_H of these solutions, with the exception of a preliminary report by Freeman and Benedict,[1] in 1930, has ever been made.

The material for study, procaine solutions in all-glass ampules, rubber-stoppered cartridges (commercially called "carpules," "anestubes," "novampuls," "unitubes," "procules," etc.) and rubber-stoppered bottles, was obtained from three sources: (1) from Samuel M. Gordon, Secretary of the Council on Dental Therapeutics of the American Dental Association; (2) from the current stock of dentists, and (3) by purchase on the open market.

SIGNIFICANCE OF p_H

The p_H of an anesthetic solution has a threefold significance in that it may influence (1) the efficiency of the anesthetic solution; (2) the induction time of anesthesia, and (3) the healing or repair of tissue in the injected area.

In 1910, it was shown by Gros[2] that the addition of an alkali to an anesthetic salt enhances the anesthetic effect. Sollmann[3] later confirmed this finding for surface, but not for infiltration, anesthesia. In 1927, Trevan and Boock[4] found this potentiation due entirely to the activity of the anesthetic base so-formed and not to that of the ion or undissociated salt. The clinical observations of Fischer,[5] Freeman,[6] Smith[7] and Harvey and DeFord[8] would seem to indicate that the alkaline anesthetic base is more rapid in its action than the acid anesthetic salt; and that the use of alkaline solutions are not accompanied by certain undesirable after-effects which sometimes follow the injection of acid solutions.

It might be pertinent to state here that the neutral point on the p_H scale is 7, and that a p_H below 7 indicates acidity, while a p_H above 7 indicates alkalinity. Thus, p_H 6 denotes an acid solution and p_H 8 an alkaline solution. A solution of p_H 5 is ten times as acid as one of p_H 6, and one of p_H 4 is similarly ten times as acid as another of p_H 5, or 100 times as acid as one of p_H 6, or 1,000 times as acid as a neutral solution of p_H 7. This fact should be borne in mind since some of the solutions examined were in the neighborhood of p_H 4. A corresponding relationship exists on the other side of the scale with

TABLE 1.—DISTRIBUTION OF SOLUTIONS ACCORDING TO TRADE NAME (GROUP 1)

Trade Name	Solutions
Waite	97
Conducto	18
Metz	10
Procosol	25
Reliance	102
Novol	210
Cook	43
Total	505

TABLE 2.—DISTRIBUTION OF SOLUTIONS ACCORDING TO TRADE NAME (COMBINED GROUPS)

Trade Name	Code Initial	Solutions
Waite	W	111
Conducto	C	18
Denpro	D	2
Metz	M	12
Procosol	P	33
Reliance	R	106
Novocol	N	298
Minimax	MX	29
Cook	CK	126
	Total	735

TABLE 3.—COMPOSITION OF PROCAINE SOLUTIONS*

Type of Container	Formulas 0 p_H	1 p_H	2 p_H	3 p_H	Combined Average p_H
All Glass	6.5	6.3	6.3	6.2	6.5
		6.5	6.5	6.8	
Rubber stopper at one end	6.5	6.2	6.3	6.1	6.3
Rubber stopper at both ends	5.8	5.7	5.8	5.7	5.7
	5.7	5.8	5.6	5.8	

*Each p_H value represents the average for each batch examined of the same composition.

TABLE 4.—VACUUM-PACKED CONTAINERS

Purchased Container	Opened Container	Elapsed Time	Description of Product	Average p_H
1/16/37	1/16/37	None	Nov. anes. No. 2	5.9
1/16/37	1/16/37	None	Nov. anes. No. 3	6.1
1/16/37	1/16/37	None	Minimax red	6.1
5/4/37	5/4/37	None	Nov. anes. No. 2	6.0
12/14/36	3/25/37	3 months	Nov. anes. No. 2	5.5
Dr. Gordon*	4/23/37	1 year	Nov. anes. No. 1	4.1
Dr. Gordon*	4/23/37	1 year	Novampul No. 1	5.2

*Containers supplied by Dr. Gordon, Secretary of the Council on Dental Therapeutics, were approximately one year old.

reference to alkalinity. The p_H of the body tissues and cells is on the alkaline side of neutrality, *i.e.*, about p_H 7.2 to p_H 7.4. (Fig. 1.)

When a solution of procaine hydrochloride is injected, anesthesia, according to some, may not begin until the anesthetic salt is changed by the tissue fluids to the anesthetic base. For example, a solution of p_H 5 is changed by the tissues to p_H 7 or higher before anesthesia occurs. This suggests a period of "waiting until the anesthetic takes effect." The injection of an alkaline solution, such as procaine borate or a freshly prepared alkaline

solution of procaine hydrochloride, does not need any reaction on the part of the tissues to liberate the anesthetic base; consequently, the anesthetic effect is supposed by some to be almost immediate. However, it is difficult to obtain satisfactory evidence that this is due solely to the base. This shorter induction time is significant in conduction anesthesia, in which ordinarily the induction period may be longer and the onset of anesthesia appears to be hastened when an alkaline anesthetic solution is injected. So many factors enter into the total local action of the anesthetic drug that it is difficult to be certain of an exact correlation between the state of the local anesthetic and change in nerve function. The impressions gained, however, may be worthy of further and controlled investigation.

For injection purposes, an anesthetic solution having a p_H nearly that of the body tissues (7.2 to 7.4) might be the most desirable. In determining the effect on tissues of procaine

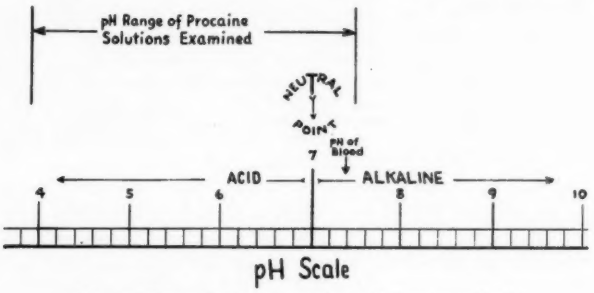


Fig. 1.—Range in p_H of procaine solutions examined.

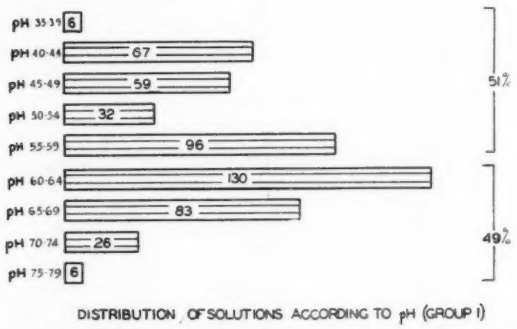


Fig. 2.—Left, p_H units. The figure in the blocked area denotes the number of solutions examined. Right, percentage of solutions below and above p_H 6.

solutions buffered to varying hydrogen-ion concentrations in unit steps from p_H 3 to p_H 8, Lawson and others[9] found that minimum irritation occurred at around p_H 7, and that irritation increased proportionately as the solution became too acid or too alkaline. They state that the "effects of solutions of p_H 7, in inducing tissue response, may be disregarded." Confirmation of these results under controlled conditions and in a large number of patients is desirable.

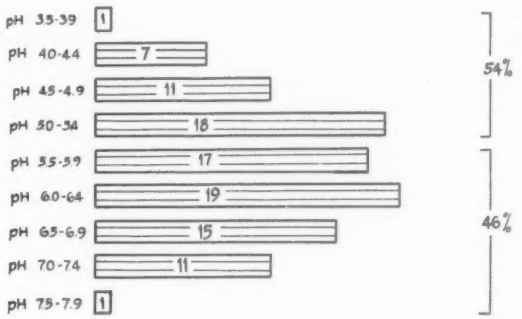
Alkaline procaine solutions are not stable, the procaine salt being acid in reaction. Alkalinized procaine solutions must be used immediately after being prepared, decompo-

sition taking place in less than an hour. The p_H of many stock solutions is not divulged by the manufacturer. Some so-called "buffered" stock solutions for which the manufacturer claims both stability and a p_H slightly below 7 are commercially available, but these claims have not been entirely confirmed. Because of this, and in view of the academic and clinical interest engendered by discussions on the p_H of local anesthetic solutions, the p_H of the more commonly used stock solutions marketed in this country was determined.

TECHNIC OF STUDY

The p_H apparatus used in this study was of the Youden potentiometric type with a Cullen quinhydrone electrode, and a saturated calomel cell as a reference electrode. The sensitivity of this instrument is said to be 0.03 p_H within a range from p_H 1 to p_H 8, and the working accuracy is within p_H 0.1. From time to time, the accuracy of the apparatus was checked against a buffer solution of known p_H.

Before a p_H determination, the ampule or cartridge was shaken to distribute the contents evenly. The glass ampule was then nicked with a file and broken, or the rubber stopper was removed in the case of a cartridge type ampule, and sufficient procaine solu-



DISTRIBUTION OF SOLUTIONS ACCORDING TO pH
(GROUP 2)

Fig. 3.—Left, p_H units. The figure in the blocked area denotes the number of solutions examined. Right, percentage of solutions below and above p_H 6.

tion was withdrawn to make the test. The time elapsing between opening the container and determining the p_H never exceeded two minutes.

The age of the solutions examined depended to some extent on the source of supply. Those purchased on the open market were as fresh as could be obtained from a large dental supply house with a quick turnover of such stock. Those obtained from dentists were from current stock on hand. Those obtained from Dr. Gordon varied in age from four to sixteen months from the date when received by him direct from the manufacturer to the time when the test was made. Some of the solutions were a little older perhaps than those generally purchased on the open market, but not necessarily older than those occasionally found "on the shelf" in the average dental office, particularly if purchases are made in lots of 100, and only a few ampules or cartridges are used from time to time.

EVALUATION OF DATA

In the first part of the study, material received from Dr. Gordon, supplemented by material purchased on the open market, was investigated. Fifty-one different batches of

solutions representing the products of seven different manufacturers were examined. With few exceptions, p_H determinations were made on eight or more solutions taken from each batch. A total of 505 solutions were examined in this group. (Table 1.) It was soon found that even when taken from the same batch, procaine solutions vary greatly in p_H. The greatest variation was as much as 1.4 p_H; *i.e.*, when taken from the same batch, the procaine solution in one ampule was p_H 5.3, while in another it was p_H 3.9. Of the 505 solutions examined in Group 1:

6 had a p_H between 3.5 to 3.9
67 had a p_H between 4.0 to 4.4
59 had a p_H between 4.5 to 4.9
32 had a p_H between 5.0 to 5.4
96 had a p_H between 5.5 to 5.9
130 had a p_H between 6.0 to 6.4
83 had a p_H between 6.5 to 6.9
26 had a p_H between 7.0 to 7.4
6 had a p_H between 7.5 to 7.9

In other words, 260 solutions, or more than half of the entire number in this group (51 per cent), had a p_H below 6; while 245 (49 per cent) had a p_H of 6 or above. Only a very small number, about 32 (6 per cent), had a p_H equal to that of the body tissues. (Fig. 2.)

In the second group, p_H determinations were made on a group of 100 ampules and cartridges collected in pairs from the current stock of fifty dentists in the Medical Arts Bldg., Philadelphia, who cooperated in this part of the study. Of the 100 solutions examined, fifty-four had a p_H value of 5.9 or below, and forty-six had a p_H value of 6 or above. These values are strikingly close to those obtained in the first group. The number of solutions having a p_H value of 7 or above was greater in this group than in the first group, the number being 12 per cent instead of 6 per cent. (Fig. 3.)

In the third group, p_H studies were made on material purchased on the open market. The data are presented in Table 2. Here again, the findings are essentially the same as in Groups 1 and 2. Perhaps the most significant finding in all three groups is the uniformly low p_H of Waite solutions. (Fig. 4.)

In the total combined groups, in which 735 procaine solutions were examined, the average p_H was as follows:

Waite	4.4	Metz	5.5	Novol	6.1
Conducto*	4.5	Procosol	5.6	Minimax	6.2
Denpro*	4.8	Reliance	6.0	Cook	6.2

The products arrange themselves conveniently with reference to p_H as follows: p_H 4+, Waite, Conducto, Denpro; p_H 5+, Metz, Procosol; p_H 6+, Reliance, Novol, Minimax, Cook.

A difference of 0.1 or 0.2 p_H does not indicate superiority of a product with regard to p_H. What is significant is whether a product falls in the p_H 4 group, p_H 5 group or p_H 6 group. (Fig. 4.)

EFFECT OF OXIDATION ON p_H

Our data tend to show that for a given composition of anesthetic solution, the p_H remained higher in the all-glass containers (average 6.5) than in the rubber-stoppered containers (average 5.7); whereas those which were rubber-stoppered only at one end occupied an intermediate position (average 6.3). (Table 3.) From this, we are led to

*Conducto and Denpro products are not acceptable for Accepted Dental Remedies. The others are listed therein.

conclude that solutions keep better in all-glass ampules than in rubber-stoppered ampules. In the latter, greater oxidation probably occurs through or around the rubber stopper, which tends to lower the p_H of the anesthetic solution. That oxidation does lower the p_H of anesthetic solutions was confirmed by three sets of observations. First, seven solutions were examined for p_H immediately after being withdrawn from their containers. The average p_H was 6.4. Ten minutes later, after exposure to the air, these solutions gave an average p_H of 6.1, and twenty minutes later, 6.0. Secondly, the p_H of procaine solutions from twenty-five freshly opened anestubes (the contents of a vacuum-packed container) was determined and found to average 6.0. The anestubes were left open for about an hour and the p_H of the solutions was again determined. The average p_H of the group had dropped to 5.6, showing a loss of 0.4 p_H. Thirdly, twenty-five anestubes and twenty-five novampuls, each about one year old, were examined for p_H. The average for the anestubes was 4.1, while the average for the novampuls was 5.2; this again showing that the p_H of the solution was better preserved in the container that had less possibility of air seepage. From this, one may conclude that (1) oxidation lowers p_H; (2) stock anesthetic solutions should be used as soon as possible after purchase; (3) if an anesthetic solution

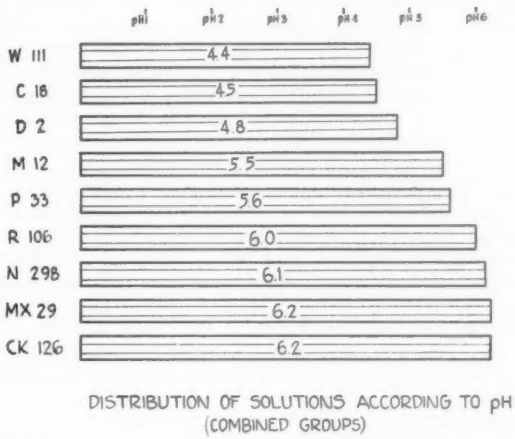


Fig. 4.—Left, letters corresponding with code letters given in Table 2, the numbers following indicating the number of solutions examined. Thus, in the first row, W 111 indicates that 111 containers of Waite solution were examined. The numbers given in the blocked areas denote the average p_H for that particular brand of procaine solution examined.

is prepared extemporaneously, only a small supply should be made up at one time; or, if a large supply is made up, it should be tightly sealed when not in use, in order to maintain the p_H level.

EFFECT OF USE OF VACUUM-PACKED CONTAINERS ON PRESERVATION OF p_H

Within the last year or longer, procaine cartridges have been available to the dental profession in sealed, vacuum-packed containers. One manufacturer who has popularized this type of package states that such solutions "retain their freshness, potency and efficacy" and "approach living tissue cells and their circulating media in physiological characteristics." The actual p_H of the marketed procaine solution is not stated. For this reason, the entire contents of four vacuum-packed containers were examined for p_H. These repre-

sented two different brands: Novol[3] and Minimax.[1] These containers were purchased on the open market from a large dental supply house on the assurance that the stock was fresh. The solutions were examined immediately after the vacuum-packed can was opened. The average p_H of seventy-five procaine solutions (Novocol) was 6.0; of twenty-five solutions (Minimax) was 6.1. The p_H of these solutions was therefore lower than that claimed by the manufacturer. Samplings in pairs of four additional freshly opened vacuum-packed containers (Novocol) taken from the current stock of dentists average p_H 5.95. One can therefore draw one of two conclusions: (1) either the p_H of the procaine solutions when packaged is lower than the manufacturer would have us believe, *i.e.*, more acid than is claimed, or else (2) deterioration occurs with age despite vacuum packing. To determine the possibility of the second factor being operative, the p_H of solutions in vacuum-packed containers of known age was studied. One sealed container was kept on the shelf for about three months after purchase. The can was then opened and the contents were examined for p_H. The average p_H was found to be 5.5, showing a drop in p_H of about 0.5 when compared with the average for "fresh stock." Two additional vacuum-packed containers about one year old (received from Dr. Gordon) were also opened and examined. (Table 4.) The average p_H of the contents of one container (anestubes) was 4.1; of another container (novampuls), 5.2, showing a further drop. That there was not so marked a drop in p_H in the novampul specimens as compared with the anestube specimens is probably due to the difference in type of ampule. (See page 1559.) One is therefore led to conclude that a definite drop in p_H does occur with the aging of solutions despite vacuum packing.

SUMMARY AND CONCLUSIONS

1. The p_H of more than 800 ready made procaine solutions obtained in the open market was found to vary from 3.9 to 7.5.
2. Even different solutions from the same batch had significant differences in p_H.
3. The average p_H of solutions (a) of four manufacturers was 6 or slightly above; (b) of two manufacturers was 5 or slightly above and (c) of three manufacturers was 4 or slightly above.
4. More than half of the solutions examined were below p_H 6.
5. For a given composition of solution, the p_H is maintained best in all-glass ampules, least in ampules which are rubber-stoppered at both ends and intermediately in ampules which are rubber-stoppered only at one end.
6. Oxidation lowers the p_H, *i.e.*, increases acidity, of procaine solutions.
7. There is no evidence as to the effectiveness of vacuum packing in preventing changes in p_H of procaine solutions with age.

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CURRENT LITERATURE

Dental Lesions and Systemic Disease

By editorial comment, attention is called in the *Journal of the American Medical Association* to the frequent connection between oral and systemic disorders, and the importance of recognizing the character and incidence of correlative symptoms.

"Acute and chronic poisoning by fluorine leaves indelible records in the teeth. The so-called blue line due to poisoning by lead, bismuth, mercury and other metals is well known. Vincent's infection associated with granulocytopenia is commonly observed. Subacute scurvy can sometimes be identified through a careful oral examination alone."

Tanchester and Sorrin (*J. Dent. Res.*, 16:69, February 1937) report a study of 1,500 patients in all stages of tuberculosis to determine whether dental or periodontal signs could be pathognomonic of tuberculosis. Referring to this study, the editorial continues:

"No excess of dental or periodontal disease, however, was found in tuberculous persons. Neither were gingivitis and erosion found more frequently, even in the presence of extreme debilitation from far advanced pulmonary tuberculosis. An unusual increase in caries, erosion or alveolar destruction was not noted. There was no evidence of decalcification of teeth that could be ascribed to a demineralization initiated by tuberculosis. . . . Secondary lesions, which occur late in the course of pulmonary tuberculosis in the form of ulcers on the tongue or buccal membranes, were uncommon. Vincent's infection did not occur more frequently in tuberculous patients than in others. Miller, however, was able to observe caries and erosion resulting from the use of lozenges with a high sugar content. Inquiries revealed that these patients were using lozenges to relieve dryness of their mouths and throats, and to prevent excessive coughing. This may help to explain why caries and erosion have been believed to be associated with tuberculosis."—*J.A.M.A.*, 109:211, July 17, 1937.

M. K. Hine.

An Investigation Into the Health of 1,530 Pre-School Children

By Peter Henderson

A thorough medical and dental examination was given 1,530 preschool children during the first six months of 1936 in England. The author states that if it were said that 60 per cent of the children here examined had physical defects, a grossly distorted picture of the health of the preschool child would be given. Consequently, defects noted were evaluated and the more prominent ones discussed. If it is agreed that unusual palpability of neck glands is not necessarily and, in fact, rarely is, a sign of disease, and that simple enlargement of the tonsils has no adverse effect on the child's health, then only a minority of preschool children will be found to have physical defects other than carious teeth. Bronchitis was the most serious and troublesome condition encountered in the investigation, 16.6 per cent giving histories of it and more than 50 per cent of these cases following an infective nasopharynx or respiratory tract condition of some other member of the family. Malnutrition was a problem of importance. On investigation, 30 per cent of 1,214 families were found to have incomes insufficient to buy food stated to be the minimum essential for health. Carious teeth became a problem only after the age of two years, but it then became a serious one and one that increased with age. Two per cent of the cases had blepharitis, a condition that was difficult to cure and tended easily to recur. In 5 per cent of the children, the tonsils were greatly enlarged or infected and merited surgical treatment. Though cervical glands were palpable in 28

per cent of the children, they only became a clinical problem in 0.78 per cent of the cases. Otorrhea was present in 3.9 per cent of the children, and 16 per cent of the children under one year of age had to have their feeding investigated. The author concludes that no great advance in the standard of health of the citizen of tomorrow can be expected until the problem of adequate feeding of all the children in the community is scientifically and thoroughly advocated.—*Arch. Dis. Childhood,* 12:157, June 1937.

VIRGIL D. CHEYNE.

Hypoplasia of the Mandible (Micrognathy) with Cleft Palate: Treatment in Early Infancy by Skeletal Traction

By A. C. CALLISTER

A BABY girl, three days old, was brought in to a pediatrician of Salt Lake City for relief of dyspnea and cyanosis. Since birth, the infant had to be held constantly in the ventral position. On examination, she was found to have marked hypoplasia of the mandible with cleft palate. The tongue was displaced so far posteriorly that when the infant was placed on her back the tongue dropped back, completely blocking respiration. Exerting forward traction on the rami of the mandible gave relief. A simple apparatus with its basis a jury-mast similar to that used in cases of fractured cervical vertebrae was constructed and traction exerted to keep the mandible well forward. Marked development of the mandible took place rapidly and the appliance was removed at the end of four weeks. —*Am. J. Dis. Child.,* 53:1057, April 1937.

VIRGIL D. CHEYNE.

A Dental Examination of the Inhabitants of Tristan Da Cunha

By H. N. V. BARNES

THE low incidence of dental disease found in 162 inhabitants of Tristan da Cunha in 1932 prompted a second examination of the whole population of 183 persons. It was found that the percentage of carious teeth had increased to 4.2 per cent as compared with 1.84 per cent in the examination five years previously. Gingivitis had increased from 3.21 to 26.20 per cent; pyorrhea from 1.22 to 4.30 per cent, and 50.3 per cent of the mouths were free from caries and extractions as compared with 83.33 per cent in 1932. The habits and diet of the community had not changed except for an increase in the consumption of sugar and flour and the introduction and use of toothbrushes. Two tables compare the observations made in 1932 and in 1937.—*Brit. D. J.,* 43:86, 1937.

B. G. BIBBY.

Local and Remote Sequelae of Infection of the Parodontal Sulcus

By E. WILFRED FISH

IT is shown that although the organisms in the parodontal sulcus are confined to the surface, traumatic interference may force them into the lymph or blood stream. Thus, local and general disturbances may result from the introduction of organisms into the blood stream as well as from toxic absorption. Local toxic absorption causes destruction of the tooth attachment, and remote effects are arthritis and fibrositis and damage to the liver, kidneys or other susceptible tissues. Dry socket is the result of traumatic bacteremia and the pyorrheic abscess of suppurative lymphangitis. Bacteremia may produce remote osteomyelitis or change a simple to a bacterial endocarditis. Methods of eliminating parodontal infection are discussed. Elimination is believed possible.—*Proc. Roy. Soc. Med.,* 30:1149, 1937.

B. G. BIBBY.

Toxicity of Sterile Filtrate From Parodontal Pockets

By J. WALLACE GRAHAM

THE toxic effect of material from pyorrhea pockets was investigated by injecting Seitz filtrates into various animals. Such material proved fatal in fifteen of twenty-five animals injected. Four cats showed fatty degeneration of the kidney tubules. In thirteen guinea-pigs, none or varying degrees of liver degeneration appeared according to the size of the injections. Six rats died in five to seven days. One of two

rabbits showed fatty change in the liver.—*Proc. Roy. Soc. Med.*, 30:1165, 1937.

B. G. BIBBY.

Nasopalatine Duct Structures and Peculiar Bony Pattern Observed in Anterior Maxillary Region

By L. W. BURKET

IN thirty-five adult anterior maxillae studied in serial section, a peculiar bony pattern was revealed in twenty-five and rudimentary nasopalatine duct structures in twenty-one. Failure to observe these structures in early sections may have been due to methods of sectioning. Gross examination revealed no abnormalities in this region, and roentgenologic evidence of a cystic lesion was thought to be present in two cases. Definite cysts were observed in 33 per cent of the series. The peculiar bony pattern observed was similiar to that described by Thoma as occurring in osteitis fibrosa. The cause and significance of this bony pattern are not known. It is believed that the portions of the nasopalatine duct which are revealed may give rise to cysts found in the anterior palatine papilla and median anterior region.—*Arch. Path.*, 23: 793, June 1937.

HAMILTON ROBINSON.

Primary Tuberculosis of the Tongue

By W. F. MARTIN

IN a patient with tuberculosis of the tongue, no other evidence of tuberculosis was found. The finding of tongue lesions in this disease is rare, *i.e.*, one in 7,165 necropsies; three in 405,408 admissions, and six in 1,500 cases as reported from various institutions. The patient, a man aged forty, had had a sore tongue for six months. A druggist had treated it with lunar caustic and subsequent examination revealed no spirochetes (dark-field examination). The ulcer, one-half by one-quarter by one-quarter inch, was on the right side of the tongue, red, indurated, with a grayish base and no free pus. Biopsy revealed chronic inflammation, probably tuberculosis, and the lesion was excised.—*South. Med. & Surg.*, 99:348, July 1937.

HAMILTON ROBINSON.

Mental Disturbance Following Atropine Administration

By P. T. DUGGAN

THREE drops of a 1 per cent solution of atropine sulfate were instilled in each eye of a boy aged ten years, as a cycloplegic to ascertain the refraction. After one-half hour, the pupils were found to be semi-dilated. Additional atropine was instilled until each eye had received approximately 5 drops. Immediately the boy's behavior became unusual. He walked with difficulty, became restless and showed signs of fright. His mind became confused and it was necessary to hold him in bed. About twenty-four hours after the administration of the atropine, his mind was again clear, and he remembered nothing of his strange actions. It would seem reasonable to assume that in this case there was an atropine idiosyncrasy, although a confirmatory injection of the drug was not given. Cases of this kind are comparatively rare.—*Brit. M. J.*, 1:918, May 1, 1937.

J. FRANK HALL.

Nature of Diet in Its Relationship to Control of Dental Caries

By J. D. BOYD, C. L. DRAIN and G. STEARNS

FIVE orphanage children (three to five years) with varied vitamin D intakes were observed in the metabolism ward over a seven-months period. Dental examination was made with an explorer, permeable exposed dentin being considered as active caries. Appreciable lessening of caries activity was noted during the first few weeks. The status became stationary for many weeks even with a high protective diet for five months, and finally the carious process was arrested nine weeks after the addition of cod-liver oil to the diet. While the hospital diet seemed adequate aside from its vitamin D content, caries was not arrested. The authors believe the level of vitamin D to be the deciding factor in arrest of decay, moderate control of the diet resulting in "near-arrest."—*Proc. Soc. Exper. Med. & Biol.*, 36:645, June 1937.

HAMILTON ROBINSON.

Experimental Alveolar Bone Atrophy Produced by Ascorbutic Acid Deficiency and Its Relation to Pyorrhea Alveolaris

By P. E. Boyle, O. A. Bessey and S. B. Wolbach

Changes in the peridental tissues due to vitamin C deficiency with resultant failure of intercellular substance to form properly were investigated. The pyorrheic, scorbutic and ascorbutic acid-inadequate diet, alveolar process and peridental tissues were identical. Roentgen-ray and histologic study revealed rarefaction of the alveolar bone and widening of the peridental membrane, with ultimate loosening of the teeth and atrophy of the bone in acute scurvy. Similar changes take place more slowly in animals at low ascorbutic levels. The bone rarefaction is a result of osteoblastic failure, and loosening or drifting of the teeth expresses a weakness of the supporting bone and the suspending fibers.—*Proc. Soc. Exper. Med. & Biol.*, 36:733, June 1937.

Hamilton Robinson.

Ranula and Syphilis

By M. Tsuzuki

The author, believing that the common explanation of ranula as a retention cyst was inadequate, investigated thirty-four cases in their relation to syphilis. In twenty-three (71.9 per cent) of these instances, the Wassermann reaction was positive. Twenty instances of ranula with positive Wassermann reactions histologically showed chronic interstitial inflammation suggestive of syphilitic changes. The author believes that the smaller, thick-walled ranulae are usually nonsyphilitic in origin, while the larger, thin-walled cysts are mostly syphilitic. The large cysts are drained and antisyphilitic treatment is administered.—*Am. J. Surg.*, 37:127, July 1937.

Hamilton Robinson.

Fatal Bleeding

By S. M. Leitess

The author has investigated the distribution of blood in the different blood vessels after profuse bleeding, and reports interesting results. 1. Bleeding from the aorta causes death more rapidly than bleeding from the femoral artery, although more blood is lost in the latter. 2. The blood content of the brain and other internal organs is high after bleeding from the carotid artery. There is no relation between the blood content of the brain and of the other internal organs. In the brain itself, the distribution of the blood varies from one part to another. The medulla and pons usually contain little blood, while much blood is found in the corpora quadrigemina. —*Arch. Sc. Biol.*, 41:133, 1936; abstr. *Brit. M. J.*

J. Frank Hall.

Xeroderma Pigmentosum with Carcinoma of the Lower Lip in Two Brothers Aged Sixteen and Thirteen Years

By E. T. Bell and T. P. Rothnem

In two brothers, labial carcinoma was recognized before the underlying dermatitis. There was no family history of cancer or skin disease. In the older boy, the lower lip had been sore for two years and two-thirds of its area was covered with a raw, ulcerated, protruding tumor. One small submaxillary lymph node was palpable. The younger boy showed a sore, encrusted lower lip for two months. Biopsy revealed squamous carcinoma in both cases and both were treated by irradiation. In view of the diagnosis of xeroderma pigmentosum, there is high probability of skin carcinoma developing and an indoor occupation is recommended.—*Am. J. Cancer*, 30:574, July 1937.

Hamilton Robinson.

PRACTICE IN PARAGRAPHS

This department is intended for busy readers. It aims to tell a vivid story in a few words. Items should be of a practical character, and free from padding—not more than a paragraph or two. We exact no limit, but two hundred words can tell most of these stories. Send in your ideas; they will be welcome.

Packing Pit Cavity Floor—Packing the floor of pit cavities with mat gold makes easy starting of gold cylinders and prevents "balling" of gold.—*A. M. Stinson, Stewartstown, Pa.*

Container for Dentures—A white porcelain enamel cup for holding dentures and removable prostheses should be conveniently placed. Patients do not like to have their dentures on display on the bracket table.—*Claude A. Moore, Lexington, Miss.*

Soap Economy—When a cake of soap is almost gone, the thin piece can be pressed flat against the new cake and made to stick tight with a piece of match stick. After being used a few times, the old cake sticks to the new, when the match may be pulled out. Thus all of the soap can be used.—*Charles A. Eller, Albuquerque, N. M.*

Fee or No Fee—Where roentgen-ray examinations are absolutely necessary, they must be resorted to, whether or not the financial status of the patient warrants it. Neglect to employ the rays is a reflection on the dentist and on his appreciation of the progress of modern dentistry. No phase of dental service impresses the patient more as to the thoroughness of the dentist. If examinations are essential, thorough examinations are imperative. Roentgenograms are visualized images, reflecting oral conditions. Whether patients understand them or not, they afford something definite to look at, to be impressed with and talk about. Any dentist can be more sure and assume less with such an invaluable aid at hand.—*Herbert Ely Williams, Red Bank, N. J.*

Better Silicate Fillings—After a good silicate powder and liquid have been properly mixed and placed in the cavity to be held under slight pressure for about three minutes, many operators make the mistake of disturbing the material during its initial setting or process of crystallization and ruin what might have been a satisfactory restoration. Too many fillings are ruined by the operator who burnishes or pats the celluloid strip over the soft plastic material and thereby draws moisture from the "mix" to the surface, unbalancing the properly homogeneous mixture produced on the slab, and, of course, weakening the whole structure. Others make the mistake of lifting the strip before the prescribed time for setting has elapsed and often see the material cling to the strip as it is pulled away from the cavity margins. When this occurs, the filling has been ruined then and there, if from no other reason. The broken parts of the material will not go back together. Good materials should be used and the manufacturer's directions followed in every detail, and silicate fillings will give better service.—*Robert L. Foster, 5703 E. Washington St., Indianapolis, Ind.*

MISCELLANY

Deaths

Alsobrook, Kyle B., Tampa, Fla.; Georgetown University, School of Dentistry, 1916; died recently.

Bauth, Carl O., Wilmette, Ill.; Chicago College of Dental Surgery, 1894; died July 6; aged 67.

Bohr, John Donovan, Oak Park, Ill.; Chicago College of Dental Surgery, 1927; died June 27; aged 33.

Boyce, A. E., Tuscola, Ill.; Indiana University School of Dentistry, 1894; died July 7; aged 77.

Bull, H. D., Jerseyville, Ill.; died April 3; aged 75.

Haas, Melville M., Evansville, Ind.; Ohio College of Dental Surgery, 1889; died July 18.

Mason, Reuben M., Sanford, Fla.; Atlanta-Southern Dental College, 1896; died recently.

Padgett, Robert C., Mansfield, O.; died July 1.

Russell, Newman Carleton, Attica, Ind.; Indiana University School of Dentistry, 1927; died June 29; aged 32.

Terry, Charles Stone, Chicago, Ill.; Northwestern University Dental School, 1889; died May 27; aged 77.

Vance, A. D., Chicago, Ill.; Chicago College of Dental Surgery, 1909; died August 3; aged 50.

BIBLIOGRAPHICAL

"The Examining Dentist in Food Hazard Cases"

By Charles A. Levinson, D.M.D. 58 pages; price, $2. Published by the Murray Printing Co., Boston, Mass. 1937.

This book discusses a subject regarding which practically nothing has previously appeared in the dental literature. It describes briefly the types of injuries most commonly incurred in biting on foreign substances in food and also discusses fraudulent claims. The book contains examination charts and examples of written reports in claim cases. The author presents some very good suggestions regarding the conduct of the examining dentist in the court room.

Any dentist preparing himself as a court witness could benefit by the suggestions contained in this book.

"How to Win Friends and Influence People"

Two copies of a current "best seller," "How to Win Friends and Influence People," by Dale Carnegie, have just been presented to the Library Bureau by a dentist who feels that he has been greatly benefited by reading this book and who wishes other dentists to have an opportunity to read it. This book can be borrowed from the Library Bureau under the usual regulations governing the borrowing of books.

"Why We Do It"

An Elementary Discussion of Human Conduct and Related Physiology. By Edward C. Mason, M.D., Ph.D., F.A.C.P., Professor of Physiology, University of Oklahoma School of Medicine, Oklahoma City. 177 pages; price $1.50. Published by the C. V. Mosby Company, St. Louis, Mo. 1937.

The subject of psychology has long been of interest to dentists. This book discusses psychology in a rather elementary way, but is novel in that the related physiology is especially emphasized. It is interesting and readable, but other books pertaining more closely to the special psychologic problems confronting the dentist have been published.

Chapter headings include: Ego Development, The Personality Triangle, Brain Mechanisms Affecting Personality, Endocrine Mechanisms Affecting Personality, Autonomic Nervous System Mechanisms Affecting Personality, Sex Development and Types of Personality.

ANNOUNCEMENTS

ANNOUNCEMENTS must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

CALENDAR OF MEETINGS

American Dental Association, St. Louis, Mo., October 24-28, 1938.

National Board of Dental Examiners, December 6-7.

American Society for the Advancement of General Anesthesia in Dentistry, New York City, fourth Monday in March and October.

Five State Postgraduate Clinic, Washington, D. C., March 6-9, 1938.

District of Columbia at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June, inclusive.

Greater New York Dental Meeting, New York City, December 6-10.

Great Lakes Association of Orthodontists, Cleveland, Ohio, November 1-2.

Northern Illinois Dental Society, La Salle, September 29-30.

Montreal (Canada) Dental Club Fall Clinic, September 22-24.

STATE SOCIETIES

September

Southern California, at Los Angeles (13-15)

November

Florida, at Hollywood (4-6)
Ohio, at Columbus (8-10)
Puerto Rico, at San Juan

December

Hawaii, at Honolulu

May

North Carolina, at Winston-Salem (2-4)

STATE BOARDS OF DENTAL EXAMINERS

Arizona, September 6. R. A. McCall, 719 Professional Bldg., Phoenix, Secretary.

California, at San Francisco, December 6. Kenneth I. Nesbitt, 450 McAllister St., San Francisco, Secretary.

Indiana, at Indianapolis, October 25. J. M. Hale, Mt. Vernon, Secretary.

Minnesota, at Minneapolis, December 10-16. Paul Hagen, Crookston, Secretary.

New Jersey, December 6-11. Walter A. Wilson, 148 W. State St., Trenton, Secretary.

Wisconsin, at Milwaukee, December 13-17. S. F. Donovan, Tomah, Secretary.

NORTH CAROLINA DENTAL SOCIETY

The Sixty-Fourth Annual Meeting of the North Carolina Dental Society will be held at the Robert E. Lee Hotel in Winston-Salem, May 2-4, 1938.

FRANK O. ALFORD, *Secretary,*
1109 First Nat'l Bank Bldg.,
Charlotte.

CALIFORNIA STATE BOARD OF DENTAL EXAMINERS

The next examination to be conducted by the Board of Dental Examiners of California for license to practice dentistry and for license to practice dental hygiene in California will be held in San Francisco commencing December 6 at the Physicians & Surgeons College of Dentistry, San Francisco. All credentials must be in the office of the secretary at least twenty days prior to the date of the examinations. Address all communications to

KENNETH I. NESBITT, *Secretary,*
450 McAllister St.,
San Francisco.

INDIANA STATE BOARD OF DENTAL EXAMINERS

The next examination for licensure of the Indiana State Board of Dental Examiners will be held in Indianapolis beginning October 25. All applications, fees and credentials must be in the hands of the secretary not later than ten days before the beginning date of the examinations. For applications, instruction to candidates and other information, address

J. M. HALE, *Secretary,*
Mt. Vernon.

MINNESOTA STATE BOARD OF DENTAL EXAMINERS

The next examination of the Minnesota State Board of Dental Examiners will be held at the School of Dentistry, University of Minnesota, Minneapolis, December 10-16, for granting licenses to practice dentistry and dental hygiene in the state, which has reciprocity with North and South Dakota. All applications must be in the hands of the secretary at least ten days previous to the examination. Address all communications to

PAUL HAGEN, *Secretary,*
Crookston.

WISCONSIN STATE BOARD OF DENTAL EXAMINERS

The Wisconsin Board of Dental Examiners will hold its next examination at Marquette Dental School, Milwaukee, December 13-17. Applications and further information can be obtained by writing to

S. F. DONOVAN, *Secretary,*
Tomah.

NATIONAL BOARD OF DENTAL EXAMINERS

The National Board of Dental Examiners will hold a session for the examination of candidates in Parts I and II, December 6-7, in such cities as five or more candidates shall request. For information and application blanks, address

MORTON J. LOEB, *Secretary,*
66 Trumbull St.,
New Haven, Conn.

GREAT LAKES ASSOCIATION OF ORTHODONTISTS

The next meeting of the Great Lakes Association of Orthodontists will be held in Cleveland, Ohio, November 1-2.

RICHARD E. BARNES, *Secretary,*
1704 Republic Bldg.,
Cleveland, Ohio.

FIVE STATE POSTGRADUATE CLINIC

The Five State Postgraduate Clinic of the District of Columbia Dental Society will be held in Washington, D. C., March 6-9, 1938.

JOSEPH F. MANLEY, *Chairman,*
Publicity Committee.

INTERNSHIP

Written examination for appointment as resident dental intern at Lincoln Hospital, Department of Hospitals, New York City, will be held during Christmas week of this year, for appointments to be made for the period from July 1, 1938, to July 1, 1939. Internship offers a thorough practical training in anesthesia, exodontia and oral surgery, with a wealth of clinical material. Two internships are available. Applications should be made at once to

M. HILLEL FELDMAN,
730 Fifth Ave.,
New York City.

UNITED STATES PATENTS
APPLICABLE OR PERTAINING TO DENTISTRY

ISSUED DURING JUNE 1937

June 1

Reissue No. 20,389, to LOUIS PICKETT. Jaw Brace.

June 8

No. 2,083,052, to EDWARD L. CHOTT. Dental Alloy and Method of Making Same.

No. 2,083,217, to EDWIN I. BROTHERS and ABE R. BROTHERS. Prophylactic Device for the Oral Cavity.

No. 2,083,487, to JOHN F. BELL. Sanitary Tooth Brush Container with Antiseptic Vial.

June 15

No. 2,083,563, to THOMAS HILL and CHESTER P. LUCAS. Orthodontic Mold Appliance.

No. 2,083,595, to HARRY CLARREN. Massaging Device for Gums.

No. 2,084,092, to RALPH KENNEY. Dental Film Holder.

June 22

No. 2,084,644, to JASON D. KINSLEY. Abrasive Compound and Means of Utilizing Same.

No. 2,084,804, to WALTER R. HENION. Anesthetizing Apparatus.

No. 2,084,873, to LOUIS J. STRAUSE. Tooth Brush.

Design No. 105,116, to EDNA OPAL LOVE and EMMETT J. MOLITOR. Design for a Combined Tooth and Gum Massager or Like Article.

June 29

No. 2,085,067, to ALFRED W. BALLARDIE. Dental Plate.

No. 2,085,155, to JAY A. HEIDBRINK. Gas Strainer and Vaporizer.

No. 2,085,268, to JACINTO M. NOUEL C. Tooth.

No. 2,085,470, to ALPHONSE F. PIEPER. Dental Syringe.

ISSUED DURING JULY 1937

July 6

No. 2,086,045, to OSCAR H. PIEPER. X-Ray Apparatus.

No. 2,086,462, to DAVID E. BOST. Dental Instrument.

No. 2,086,483, to ENRIQUE G. TOUCEDA and HAROLD C. TIFFT. Means for Melting and Molding Materials.

Design 105,249, to HARRY J. RUSSELL. Design for a Dental Shade Guide.

July 13

No. 2,086,656, to CHARLES MAYNARD WOODWARD. Dental Fracture Wiring Shield.

No. 2,087,014, to CARL E. BECKER. Tooth Mold.

No. 2,087,047, to ROBERT SCHEVEN. Lock Attachment for Dental Bridgework.

July 20

No. 2,087,654, to ALPHONSE F. PIEPER. Dental Unit.

July 27

No. 2,087,932, to ALBERT ZOLA and HARRY BIRNBAUM. Dental Stool.

No. 2,088,304, to DAN D. MIZZY. Apparatus for Preparing Amalgam for Dental and Other Uses.

No. 2,088,338, to ISIDOR A. POPPER and WILLIAM A. RANDALL. Hypodermic Needle and Novel Hub for Same.

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